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ERRATA

NSA Vol. 9, No. 2, p. 105. In abstract 816, V. T. Knozyainob should be V. T. Khozyainov.

NSA Vol. 9, No. 8, p. 379. In abstract 2945, L. Reiffels should be L. Reiffel.

NSA Vol. 9, No. 9, p. 393. In abstract 3056, A. I. Shatenstein should be A. I. Shatenshtein.

NSA Vol. 9, No. 10, p. 457. In abstract 3549, Report No. AD-48094 should be AD-48095.

NSA Vol. 9, No. 11, p. 513. In abstract 3993, C. E. Mandville should be C. E. Mandeville.

GENERAL

ATOMIC POWER

5203 DL-17

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

POSSIBILITIES OF GENERATING ATOMIC ELECTRIC POWER AT COMPETITIVE RATES. W. B. Lewis. Apr. 12, 1955. 24p. (AECL-178)

Cost factors for a 100,000-kw commercial electric power plant are compared when fueled by coal and by atomic energy. The characteristics of various reactor types are reviewed. For this study a regenerative, solid fueled, heavy-water-cooled and moderated reactor, characterized by a very high specific rate of fission and low neutron wastage was chosen. The efficiency for conversion of thermal energy from steam to electricity is compared with that from U, criteria for the choice of a practical cycle for the fissile fuel are summarized, and reactor and heavy water costs are discussed. It is concluded that the nuclear power plant has not yet arrived at the stage where accurate cost estimates are available, but we now have reasonable assurance of low fuel costs for thermal reactors and it is expected that reactor costs can be brought to a level at which nuclear power generation is economically competitive. (C.H.)

5204

A PROGRAMME OF NUCLEAR POWER. London, Her Majesty's Stationery Office, 1955. \$0.25.

A provisional program for nuclear power has been prepared by the British government. The first 10 years are covered in detail, and probable developments in the following 10 years are indicated. The two types of reactors that are expected to be in use commercially by 1965 are gas-cooled and liquid-cooled thermal reactors. The probable cost of nuclear power is estimated. The provisional program calls for 2 gas-cooled graphite-moderated stations, each with 2 reactors, to be in operation by 1960 or 1961. Two additional stations should be in operation by 1963, and 8 more should be completed by 1965, providing a capacity of 1500 to 2000 Mw. (M.P.G.)

5205

NUCLEAR POWER: A MULTIBILLION DOLLAR BUSINESS BY '63. Nucleonics 13, No. 6, 80-1(1955) June.

The main conclusions of the growth survey of atomic industry by the Atomic Industrial Forum are summarized. Graphs and tables are presented on the expected growth of nuclear power plant capacity and dollar volume of nuclear reactor plant expenditures from 1955 to 1964, the projected nuclear component market in millions of dollars by 1963, and estimated fuel requirements to 1965. (M.P.G.)

RESEARCH PROGRAMS

5206 BNL-337

Brookhaven National Lab., Upton, N. Y.

QUARTERLY PROGRESS REPORT [FOR] JANUARY 1-

MARCH 31, 1955. (UNCLASSIFIED SECTION). 61p.

Abstracts are given for research activities being reported concurrently in the scientific journals, with appropriate journal references. Cosmotron improvements made during the shutdown period are briefly discussed. Work on the alternating gradient synchrotron is continuing, and the status of development of the electron analogue, the magnet, r-f cavity, and buildings are summarized. Resonance parameters from total cross section measurements on In are listed. The maximum energy available for the $\text{He}^6 \rightarrow \text{Li}^6$ transition was measured. A millimicrosecond pulse generator, a grey wedge pulse height analyzer, and a survey meter are described. Nematodes subjected to 20,000 r of x rays were found to lay eggs which fail to develop. Preliminary data are presented from studies on the thyroid accumulation of Re^{188} ; the radiosensitivity of encapsulated and nonencapsulated pneumococci; the incorporation of C^{14} -labeled amino acids by *Trichinella spiralis* larvae and host tissue; the characterization of a glycoprotein in the urine of patients with proteinuria; Mn metabolism; the effect of nutritional state on radiosensitivity of the skin in rats; and Na-K transport in human red cells. (For preceding period see BNL-326.) (C.H.)

5207

NUCLEAR RESEARCH IN NORWAY. A. W. McReynolds (Brookhaven National Lab., Upton, N.Y.). Phys. Today 8, 13-16(1955) Apr.

The research being carried on in Norway by the universities, research institutes, and JENER is summarized. The educational sequence for Norwegian students is described. A very brief description of nuclear research in Sweden is presented. (M.P.G.)

BIOLOGY AND MEDICINE

5208

ON THE RELATION BETWEEN FUNCTIONAL ACTIVITY AND AND ALBUMIN RESTORATION IN THE PLACENTA ON RADIOGRAPHIC EVIDENCE. Z. P. Zhemkova (Inst. of Experimental Medicine and Inst. of Oncology). Doklady Akad. Nauk S.S.S.R. 101, 117-19(1955) Apr. 21. (In Russian)

Albumin metabolism in rabbit, guinea pig, and cat placentas was studied by means of S^{35} tracer and autoradiograms. (G.Y.)

RADIATION EFFECTS

5209 AECU-3033

Utah. Univ., Salt Lake City. Radiobiology Lab. and Los Alamos Scientific Lab., N. Mex.

THE EFFECTS OF ACUTE WHOLE-BODY X-IRRADIATION ON THE ABSORPTION AND DISTRIBUTION OF Na^{22} AND H^3OH FROM THE GASTROINTESTINAL TRACT OF THE FASTED RAT. Charles J. Goodner, Thomas E. Moore, Jr., John Z. Bowers, and Wallace D. Armstrong. [1954?]. 51p. Contract [W-7405-eng-36].

5210 UCRL-2987

California. Univ., Berkeley. Radiation Lab.
**EARLY CIRCULATORY DISTURBANCES FOLLOWING
 EXPERIMENTAL THERMAL TRAUMA.** Ernest L.
 Dobson and George F. Warner. May 11, 1955. 17p.
 Contract W-7405-eng-48.

Anaesthetized dogs were scalded by immersion in hot water, and determinations were made, before and after the burns, of cardiac output, liver blood flow, blood volume, ECG and pulse contours. Prompt and severe reductions in cardiac output and marked decreases in liver blood flow were observed and severe ECG and pulse disturbances were found. Plasma volume losses appeared to be inadequate to account for the marked changes observed. Early myocardial depression as one possible cause of these changes is discussed. (auth)

5211 UR-386

Rochester, N. Y. Univ. Atomic Energy Project.
**THE SUB-FABRIC FLASH BURN: QUANTITATIVE EFFECT
 ON PROTECTIVITY OF FABRIC REFLECTANCE, FABRIC
 WEIGHT AND EXPOSURE TIME.** George Mixter, Jr., T. P.
 Davis, and H. E. Pearse. May 2, 1955. 44p. Contract
 W-7401-eng-49.

Cotton sateens impregnated with carboxymethyl-cellulose and varying quantities of carbon black were used in a systematic study of burn production as a function of reflectance and of fabric weight in relation to exposure time. A modified carbon arc provided the source of thermal energy; anesthetized white pigs were used as indicators. Reflectances and weights of the fabrics were determined in this laboratory. Exposure-response tables and probit analyses are presented to show the empiric dependence of protectivity upon these three parameters. The protective index of these fabrics was established. Separation of fabric by 0.5 cm from skin increases the protective index from two to four times this value. (auth)

5212 UR-394

Rochester, N. Y. Univ. Atomic Energy Project.
**STUDIES OF FLASH BURNS. THE RELATION OF THER-
 MAL ENERGY APPLIED AND EXPOSURE TIME TO BURN
 SEVERITY.** J. L. Lyon, T. P. Davis, and H. E. Pearse.
 Apr. 30, 1954. 27p. Contract W-7401-eng-49.

The principle objective of these experiments was to construct a dose-response pattern for the reaction of pig skin to radiant thermal energy over a wide range of exposure times, and radiant exposures. This was done by a carefully controlled study of the gross and histologic appearance of 1735 burns produced by the carbon arc. The data were subjected to probit transformation in order to obtain 50% median effective exposures. Absolute reciprocity between total energy and time of application was not demonstrated for surface lesions graded 1+ severe or more. This was also true for burns judged from their microscopic appearance, except for mid and deep dermal injury where a reverse reciprocity relationship existed. Each surface burn was compared with its respective microscopic appearance, and from this it was demonstrated that for the gross lesions graded 1+ and 2+, an increase in exposure time did not effect the depth of damage. But for 3+, 4+ and 5+ burns prolonging the exposure time beyond one second had a marked effect on the depth penetration. A comparison was made of the results of this experiment with previously obtained information on humans. It was found that the energy requirements for 1+ mild burns on pigs are

similar to those for minimal erythema in humans. In addition, the energy necessary to produce a 2+ mild pig lesion is comparable to that for major vesiculation of human skin. (auth)

5213 USNRDL-TR-36

Naval Radiological Defense Lab., San Francisco.
**THE EFFECTS OF TOTAL-BODY FAST NEUTRON IR-
 RADIATION IN DOGS.** V. P. Bond, R. E. Carter, J. S.
 Robertson, P. H. Seymour, and H. H. Hechter. Jan. 10,
 1955. 30p. (AFSWP-760)

The 60-in. Crocker Laboratory Cyclotron of the University of California was used to expose dogs to single doses of fast neutrons (mean energy approximately 9 Mev) and acute effects were compared with those seen following 250 kvp x irradiation. The relative biological effectiveness of the neutron radiation, taken as the LD₅₀ values expressed as rep delivered to the median sagittal plane, was 0.8. X-ray and neutron depth-dose curves indicated that with the bilateral radiation employed, distribution of dose throughout the thickness of the animals was essentially uniform with both types of radiation. No significant differences between dogs heavily irradiated with x or neutron radiation were found with respect to signs of illness, survival time, blood count changes, and gross microscopic pathology. (auth)

5214

ELECTROPHYSIOLOGY OF THE X-RAY PHOSPHENE. Leo
 E. Lipetz (Univ. of California, Berkeley). Radiation
 Research 2, 306-29(1955) June.

An attempt was made to test the hypothesis that the x-ray phosphene results from a direct action of the rays on the photochemicals of the retinal rods and cones. The electrical discharges of a single ganglion cell of a frog retina in situ were detected as an objective measure of the retinal response. Results are summarized. (auth)

5215

**RESPONSE OF THE BAT (*MYOTIS LUCIFUGUS*) TO X-
 IRRADIATION.** Douglas E. Smith, Donald R. Russ, and
 Eugenia M. Jackson (Argonne National Lab., Lemont, Ill.).
Radiation Research 2, 330-8(1955) June.

Survival, blood, and histological studies were made in the bat (*Myotis lucifugus*) maintained in the laboratory at 23° C and exposed to x-rays (500 to 50,000 r). Nonirradiated starving bats survived much longer early than later in hibernation. In November experiments dosages as low as 500 r significantly shortened the life span of starving bats, but in February and March, exposures to 500 to 20,000 r were followed by survival times similar to those of simultaneously starved controls. Leucocytes were depressed by as little as 500 r, but the erythrocytes remained unchanged even after 20,000 r. Typical irradiation effects were found in bone marrow, spleen, lymph node, and duodenum after dosages as low as 500 r. These findings are compared with those of other irradiated mammals and frogs in an effort to establish the radiosensitivity of the bat. (auth)

5216

**EVIDENCE FOR TWO TYPES OF X-RAY-INDUCED LE-
 THAL DAMAGE IN *SACCHAROMYCES CEREVISIAE*.**
 Robert K. Mortimer (Univ. of California, Berkeley). Radia-
 tion Research 2, 361-8(1955) June.

Under proper conditions, haploid yeast cells of opposite mating types will conjugate when placed together by micro-manipulative techniques. When one of the two parent cells is x-irradiated before pairing, conjugation usually occurs nor-

mally, but the diploid zygote formed shows many evidences of radiation damage. These include division delay, abnormal division, swelling, and death. The percentage of inviable zygotes increases with dose in a multiple-hit fashion. Irradiation of the one haploid parent in a nitrogen atmosphere results in a twofold effective dose reduction in the zygote survival curve. The reduction in zygote viability is found to be the same for irradiation of either parent cell. Irradiation of both parent cells before pairing results in a much larger reduction in zygote viability compared with the case where only one parent is irradiated. Doses which are lethal to a relatively large percentage of the irradiated haploid cells (i.e., 99.9%) still result in a relatively high zygote survival (i.e., 50%). Thus, many haploid cells receive damage which is lethal in the haploid state but which is nonlethal when incorporated into a diploid cell containing a normal set of alleles. This type of damage could correspond to recessive lethal mutations. The damage which is expressed in the diploid zygote is considered as dominant lethal, although the present study does not allow its positive identification with any particular component of the irradiated cell. The relative frequency of recessive lethal to dominant lethal damage in a haploid cell is about 15:1. X-ray-induced inactivation in diploid, triploid, and tetraploid cells is predicted to be primarily of the dominant lethal type, inactivation due to pairing of recessive lethals playing a minor role. (auth)

5217

SENSITIVITY AND TIME FOR DEGENERATION OF SPERMATOGONIC CELLS IRRADIATED IN VARIOUS STAGES OF MATURATION IN THE MOUSE. Eugene F. Oakberg (Oak Ridge National Lab., Tenn.). Radiation Research 2, 369-91 (1955) June.

Reduction in number of spermatogonia after irradiation can be explained by killing of cells, without postulating a prolonged mitotic inhibition of type A spermatogonia. Degeneration of spermatogonia occurs primarily as damaged cells reach late interphase or early prophase of their first post-radiation division. A few cells may undergo one or more divisions before degenerating. Irradiation damage to primary spermatocytes remains latent until the cells enter meiotic metaphase and anaphase. Many abnormal figures typical of chromosomal aberrations then occur, and nuclei of resulting spermatids show an abnormal size variation. Spermatids and sperm show no visible changes with doses up to 1500 r. However, numerous investigators have established the sensitivity of these cells to genetic damage which is expressed after fertilization. Intermediate and type B spermatogonia are extremely sensitive to radiation. Type A spermatogonia are of heterogeneous sensitivities depending on mitotic activity and stage of development. Spermatogenic cells in the mouse show quantitative and qualitative differences in sensitivity that are correlated with the dramatic nuclear changes in spermatogenesis. The inference is clear that the primary reactions determining behavior of these cells is nuclear. This conclusion is strengthened by the fact that, when similar correlations between sensitivity and nuclear state at time of irradiation are observed in favorable cytological material, the damage proves to be chromosomal. (auth)

5218

EFFECT OF FREE-RADICAL ACCEPTORS ON RADIO-SENSITIVITY OF *PSEUDOMONAS FLUORESCENS*. Philip S. Rane and Samuel A. Goldblith (Massachusetts Inst. of Tech., Cambridge). Nucleonics 13, No. 6, 82(1955) June.
To determine the effect of free-radical acceptors (FRA)

on the radiosensitivity of microorganisms in food, cultures of *Pseudomonas fluorescens* were irradiated in nutrient broth and pea purée suspensions with and without FRA's. Sodium ascorbate and a combination of disodium fumarate and monosodium glutamate were the FRA's used. The data are summarized in a table and indicate that the inactivation dose is increased in the presence of FRA's. The results add further evidence to the theory that microorganisms are destroyed by ionizing radiations indirectly as well as by direct hits. (M.P.G.)

5219

INVESTIGATION OF MORPHOLOGICAL TISSUE RESPONSE TO RADIOPHOSPHORUS. W. Hellriegel and H. Pauly. Strahlentherapie 96, 557-68(1955) Apr. (In German)

The author investigated in 2 experimental series the influence of P^{32} on testicles, liver, spleen and kidneys of healthy mice. In the first series, he studied the distribution of the radiophosphorus in the organs and its gradual excretion during the first two weeks following its administration. At the same time he converted into equivalents of roentgen the radiation delivered to the entire organism and to the individual organs. 22.5 mc of radiophosphorus were administered to each animal which, after two weeks of continuous β -radiation, adds up to a total body irradiation of 577.3r (mean value). The distribution of the activity in the organs and the entire organism is shown in tables. In the second series the author investigated the morphological changes in the cell nuclei and cellular groups following intensive β -irradiation. Each animal received a total dose of 52.5 mc P^{32} . This dose is approximately 2 to 3 times higher than the therapeutic dose. As no selective storage takes place during the first days following the administration, severe disturbances are induced in the cells and the tissue of the examined organs. Due to the fact that the tissular damages are generally incurable, the author cautions against a casual application of radiophosphorus. (auth)

5220

THE EFFECT OF SMALL DOSES OF X RADIATION ON BONE MARROW. Ilse Martin, Rudolph Pape, and Alexandra Piringer-Kuchinka. Strahlentherapie 96, 569-75(1955) Apr. (In German)

The authors investigated the influence of rather high and of minimum doses of roentgen rays on the bone marrow, while taking into account the meromitosis as a special form of proliferation. Their studies confirmed the data of other authors with respect to doses of 600 r. Doses from 5 to 20 r seem to exert a mild stimulus to proliferation. It seems advisable to distinguish between vital and functional radiosensitivity. (auth)

5221

EFFECTS OF RADIATION ON THE BLOOD PICTURE. Ernst Spode. Strahlentherapie 96, 595-8(1955) Apr. (In German)

The author reports on examinations of the blood-picture in albinotic rabbits following a single irradiation with rays of the spectral range below 280 m μ (UVC). No effect of the radiation was observed. This is explained by the assumption that the delivered energy is absorbed prior to its reaching the vegetative terminal arborization of the skin. (auth)

5222

AN INVESTIGATION OF THE EFFECTS OF IRRADIATION ON SODIUM-POTASSIUM EXCHANGE IN ERYTHROCYTES. Adolf Morezek. Strahlentherapie 96, 618-24(1955) Apr. (In German)

In tests with heparinized blood it was found that, under the influence of roentgen rays, the erythrocytes are losing their capacity of accumulating potassium ions from the plasma against the high concentration gradient and that instead of this process, part of the cellular K^+ migrates into the medium. This migration continues beyond the period of irradiation. The loss is compensated by the intake of an equivalent amount of Na^+ from the plasma. Within a range of 1000 to 16000 r, the author ascertained a linear dependence of the exchanged number of ions on the radiation dose. (auth)

5223

ON THE PROBLEM OF THE BEHAVIOR OF SERUM MAGNESIUM LEVELS IN THE COURSE OF DEEP X RAY THERAPY. Hans-Joachim Maurer. *Strahlentherapie* 96, 629-31(1955) Apr. (In German)

On the basis of radiobiochemical investigations, the question is raised whether and to which extent the contents of magnesium in the serum is changed under the influence of therapeutical radiation doses and if so, whether these changes are preceding the already previously described ATP fluctuations. No characteristic changes of the contents of magnesium in the serum were, however, found, as contrasted with observations regarding the behavior of ATP and other substances in the same patients. Further problems in this connection are briefly discussed. (auth)

5224

MOTILITY AND MORPHOLOGY OF HUMAN SPERM AFTER EXPOSURE TO LONG WAVELENGTH X RADIATION. Georg Gerber. *Strahlentherapie* 96, 632-6(1955) Apr. (In German)

Human sperms were irradiated with the Dermopan equipment. After irradiation with 55,000 r, one half of the sperms had still preserved their mobility. Thereafter the decrease in mobility continued at a faster rate, as compared to the non-irradiated controls. If non-irradiated sperms were brought into an irradiated medium, they equally lost their mobility. (auth)

5225

SEQUELAE OF REARING HABROBRACON ON RADIOACTIVE HOST LARVAE. Daniel S. Grosch and Robert L. Sullivan (North Carolina State Coll., Raleigh). *Growth* 18, 191-205(1954)

Radiophosphorus at 48 dilutions was injected by capillary needle into paralyzed Ephestia larvae. Habrobracon eggs were then transferred to these hosts as well as to controls, both injected and non-injected. Results are summarized. (auth)

5226

GENETIC DAMAGE PRODUCED BY RADIATION. H. J. Muller (Indiana Univ., Bloomington). *Science* 121, 837-40 (1955) June 17.

The author expresses his conviction that radiations of the types derived from radioactive substances or x-ray machines produce permanent changes, or mutations, in the hereditary constitution of living things of all kinds. The most numerous and important of these changes, occurring in the individual hereditary particles, or genes, are therefore called gene mutations, and arise with a frequency depending proportionally on the total dose of radiation. For instance, one-tenth of a given dose produces one-tenth of the number of gene mutations, no matter in how long or short a time that total dose was received. No exposure is so tiny that it does not carry its corresponding mutational risk. The genetic effects of test explosions are considered and the

need for perspective in considering the subject is stressed. It is pointed out that present evidence indicates that relative to the natural mutations already present in the total American population, those produced by the test explosions form only a minute contingent. It is concluded that the estimate of genetic damage must be weighed against the potential benefits to be derived from the tests, or rather, against the probable damage to our society that would follow from the alternative policy. (C.H.)

5227

EFFECT OF FEEDING DOGS THE FLESH OF LETHALLY IRRADIATED COWS AND SHEEP. R. H. Wasserman and B. F. Trum (Univ. of Tennessee, Oak Ridge). *Science* 121, 894-6(1955) June 24.

Analysis of data on weight gain, hematological findings, blood chemical determinations, and results of gross and histopathological examinations showed no statistical differences in dogs fed on a diet consisting largely of meat from lethally irradiated cattle and sheep and control animals fed meat from non-irradiated animals. (C.H.)

5228

LEUCOCYTE ADHESIVENESS FOLLOWING WHOLE BODY IRRADIATION. J. Philip Savitsky (Jewish Hospital Association, Cincinnati). *Am. J. Physiol.* 181, 215-17(1955) Apr.

There is an increased leucocyte adhesiveness following whole body irradiation of the dog and the guinea pig. These changes are demonstrable within 15 hours after irradiation, prior to the development of the subsequent leucopenia. There is a substance in the plasma of the irradiated dog which acts on normal leucocytes in vitro to increase their adhesiveness. There is present in beef spleen a water-soluble, heat-stable, dialyzable substance which can neutralize in vitro and in vivo the effect of plasma from an irradiated animal on the leucocyte adhesiveness. Complete correction of the defect in leucocyte adhesiveness in the irradiated animals by the injection of a splenic extract of the leucocyte adhesiveness factor did not alter in any way the leukopenia or the survival. (auth)

5229

A CYTOLOGIC STUDY OF THE INTESTINAL EPITHELIUM OF THE MOUSE AFTER TOTAL-BODY X IRRADIATION. William Montagna and J. Walter Wilson (Brown Univ., Providence, R. I.). *J. Natl. Cancer Inst.* 15, 1703-35(1955) June.

5230

EFFECT OF WHOLE-BODY X-IRRADIATION ON UPTAKE OF IRON BY DUCK ERYTHROCYTES. J. Raymond Klein and Ralph Cavellieri (Brookhaven National Lab., Upton, N. Y.). *Proc. Soc. Exptl. Biol. Med.* 89, 28-31(1955) May.

Whole-body x-irradiation of the duck is followed by a decrease in the uptake of iron by erythrocytes in vitro. The decrease is attributable to a decrease in number of one kind of reticulocyte, which appears to be the youngest circulating erythrocyte. The level of these cells in blood falls because of a decrease in erythropoiesis and the usual maturation of these cells, which is accompanied by a loss in ability to remove iron from plasma. (auth)

5231

EFFECT OF ROENTGEN IRRADIATION AND OTHER TYPES OF INJURIOUS AGENTS ON CAPILLARIES. Peter Rieser (Univ. of Pennsylvania, Philadelphia). *Proc. Soc. Exptl. Biol. Med.* 89, 39-41(1955) May.

By means of a microinjection method it was possible to measure the fragility of mesenteric capillaries of the frog.

Roentgen irradiation, heparin injection, trypsin and peptone shock increase the fragility of the capillaries. The increased capillary fragility appears to be a consequence of a liberation of heparin into the circulation of the animals, due to the irradiation or shock treatments. (auth)

5232

COMPARISON OF BACTERIA ISOLATED FROM BLOOD TISSUES AND FECES OF X-IRRADIATED MICE. W. T. Bradner, S. E. Bernstein, and R. E. McCarthy (Brown Univ., Providence, R. I.). Proc. Soc. Exptl. Biol. Med. **89**, 107-11 (1955) May.

A serological comparison of bacteria isolated from the blood, tissues and feces of x-irradiated mice has been made. Three species of organisms were studied in this manner: Proteus mirabilis, Paracolobactrum coliforme and Pseudomonas aeruginosa. The results indicate that the organisms found in the blood and organs of the x-irradiated mice were serologically identical to bacteria of the same species found in the feces. (auth)

5233

CHROMOSOMAL ABERRATIONS IN DATURA DUE TO VARIOUS KINDS OF IRRADIATION. Jean M. Cummings, Lewis Goldstein, and A. F. Blakeslee (Western Reserve Univ., Cleveland, Ohio and Smith Coll., Northampton, Mass.). Proc. Natl. Acad. Sci. U. S. A. **41**, 355-8 (1955) June.

X rays, thermal neutrons, and fast neutrons from a nuclear detonation and from a cyclotron cause qualitatively similar chromosomal aberrations in *Datura*. Thermal neutrons are very damaging to *Datura* and may cause a higher frequency of rings of four plus rings of six than is caused by other radiations. Cyclotron neutrons were not as effective in causing chromosomal aberrations as were neutrons from a nuclear detonation. The reason for this is unknown. (auth)

RADIATION HAZARDS AND PROTECTION

5234

A CLINICAL TRIAL OF CYSTEINAMINE (BETA-MERCAPTOETHYLAMINE) IN RADIATION SICKNESS. W. M. Court Brown (Postgraduate Medical School of London). Brit. J. Radiol. **28**, 325-6 (1955) June.

5235

POTENTIAL RADIATION HAZARDS IN THE USE OF X-RAY DIFFRACTION EQUIPMENT. J. E. McLaughlin, Jr. and Hanson Blatz (USAEC Health and Safety Lab., New York). Am. Ind. Hyg. Quart. **16**, 108-12 (1955) June.

5236

EFFECT OF MENADIOL DIPHOSPHATE (SYNKAVITE) ON THE SENSITIVITY OF *E. COLI* AND *S. CEREVISIAE* TO X-RAYS. Henry I. Kohn and Shirley E. Gunter (Univ. of California School of Medicine, San Francisco). Radiation Research **2**, 351-3 (1955) June.

5237

MODE OF ACTION OF SOME SUBSTANCES WHICH PROTECT AGAINST THE LETHAL EFFECTS OF X-RAYS. P. Alexander, Z. M. Bacq, S. F. Cousins, M. Fox, A. Herve, and J. Lazar (Royal Cancer Hospital, London and Imperial College of Science, London and Univ. of Liège, Belgium). Radiation Research **2**, 392-415 (1955) June.

More than one hundred substances have been studied as protective agents against x-rays in two completely different systems; mortality of mice, and degradation of dilute solutions of polymethacrylic acid in aerated water. A significant parallelism was found for the protective action. Different

substances were placed in the same order of effectiveness, both for compounds in the same class (e.g., amines) and for compounds of widely different chemical constitution (e.g., fatty acids and chelating agents). Results are summarized. (auth)

5238

EFFECT OF HYPOPHYSECTOMY ON SURVIVAL AFTER X-IRRADIATION. J. F. Kent, B. L. Baker, E. C. Pliske, J. G. Van Dyke, and F. H. Bethell (Univ. of Michigan, Ann Arbor). Proc. Soc. Exptl. Biol. Med. **89**, 142-5 (1955) May.

Hypophysectomy of 433 adult female rats reduced their capacity to survive total body x-irradiation as compared with the response of 542 non-hypophysectomized rats. The 0 to 70% levels of survival were obtained at doses which averaged 157 r lower for hypophysectomized than for non-hypophysectomized rats. At doses ranging from 375 to 500 r the percentage of survival of hypophysectomized rats did not change but remained at about the 80% level. In the absence of the pituitary gland, rats tended to die earlier after irradiation. (auth)

5239

CONCERNING THE PROBLEM OF RADIATION PROTECTION BY INTRAVENOUS INJECTION OF ADENOSINE-TRIPHOSPHATE. Hans-Joachim Maurer. Strahlentherapie **96**, 625-8 (1955) Apr. (In German).

The author reports on experiments in which he studied the question, whether the nucleotide ATP is apt to effectively protect the patient from radiolesions, as could have been assumed from Minaev's investigations. Although the ATP blood level of the 5 male rabbits had each time risen after intravenous ATP injections had been administered prior to the irradiation, it always dropped below its normal value within 5 days following the total body irradiation. This means that the same situation prevails as in cases where no ATP had been injected. ATP injections neither served to prolong the survival time which, as a matter of fact, even seemed to be shortened. This unfavorable influence of ATP is attributed to an increased stress, being exerted on the heart and the circulation. (auth)

5240

PHARMACOLOGY OF IONIZING RADIATIONS. Werner Lorenz. Strahlentherapie **97**, 46-63 (1955) May. (In German)

The author demands that all cancer patients receiving radiotherapy, be submitted to a general treatment prior to, parallel with and after the application of radiotherapy. He stresses, and demonstrates in animal experiments, the importance of vegetative-hormonal regulations. From the viewpoint of functional pathology the position of patients submitted to radiotherapy is a particular one. This situation therefore calls for a further development of radiopharmacology, covering the fields of research, instruction and practice. (auth)

RADIOTHERAPY

5241

THYROID CARCINOMA. A REPORT ON THE DIAGNOSTIC AND THERAPEUTIC USE OF RADIO-IODINE. S. Kramer (St. Boniface Hospital, Manitoba, Canada) and J. P. Concannon, H. D. Evans, and G. M. Clark (Royal Cancer Hospital, London). Brit. J. Radiol. **28**, 307-13 (1955) June.

Forty-eight patients with carcinoma of the thyroid have been investigated with I^{131} at the Royal Cancer Hospital, and of 13 patients who had some iodine uptake in the tumor, 12 were treated with radioactive iodine. Five patients showed

evidence of improvement, one patient with widespread pulmonary metastases being alive and well and clinically free from disease five years following therapy. Procedures designed to enhance iodine concentration have been adopted; no help was obtained by thyroid ablation where uptake in tumor had been negligible in the presence of normal thyroid tissue, but some confirmation of the reports that thiouracil may be helpful in this respect was found. The value of a whole-body scan in detecting metastases previously unsuspected has been clearly demonstrated. The diagnostic use of the automatic scanner is illustrated. (auth)

5242

PROTRACTED INTERSTITIAL IRRADIATION OF TUMORS USING ^{182}Ta . Lionel Cohen (Johannesburg General Hospital, South Africa). *Brit. J. Radiol.* **28**, 338-40(1955) June.

5243

RADIOACTIVE YTTRIUM (Y^{90}) AS A POSSIBLE ADJUNCT IN THE TREATMENT OF PAPILLOMATOSIS OF THE URINARY BLADDER. J. Einhorn, L. G. Larsson, and Inger Ragnhult. *Acta Radiol.* **43**, 298-304(1955) Apr.

The properties of a β -emitting radioactive solution which may be directly introduced into the urinary bladder for the treatment of superficial papillomatosis are discussed. The authors demonstrate that Y^{90}Cl_3 with carrier yttrium and a chelating agent (EDTA) could be kept in stable solution with only negligible absorption through the normal urinary bladder. (auth)

5244

MALIGNANT EPIBULBAR MELANOMA. REPORT ON 35 PATIENTS. G. Notter. *Strahlentherapie* **96**, 517-37(1955) Apr. (In German)

The case histories of 35 histologically confirmed cases of malignant epibulbar melanoma are summarized. Fourteen patients died from metastases, 6 of the 20 healed cases died as a result of intercurrent diseases, 14 patients are reported living and free from symptoms, and one is reported living with a local relapse. The 5-year cure rate is 43% and the 10-year cure rate 28%. The author recommends radiotherapy with Sr^{90} or with soft x rays. (C.H.)

TRACER APPLICATIONS

5245 BNL-2305

Brookhaven National Lab., Upton, N. Y.
STUDIES ON THE THYROIDAL ACCUMULATION OF RHENIUM IN THE RAT. C. J. Shellabarger. [1955?]. 25p.

5246 USNRDL-TR-34

Naval Radiological Defense Lab., San Francisco.
CIRCULATORY PATHWAYS IN THE RAT LIVER AS REVEALED BY P^{32} CHROMIC PHOSPHATE COLLOID UPTAKE IN THE ISOLATED PERFUSED LIVER PREPARATION. R. W. Brauer, G. F. Leong, R. F. McElroy, and R. J. Holloway. Feb. 21, 1955. 32p.

The isolated rat liver, able to vary perfusion rates, is used in a study of the role of blood flow and hematocrit in the efficiency of extraction of P^{32} -labeled chromic phosphate colloid. It was found that extraction of colloid by the liver from blood decreases as blood flow increases and blood flow changes result in reversible extraction efficiency changes. At the same perfusion rate, extraction is more complete for the whole blood than for the plasma-perfused liver. At comparable blood flow rates, the liver

in vitro extracts the colloid as efficiently as does the liver in vivo. It is indicated that such data can be applied to the intact animal, hemodynamic factors can affect the functioning of the liver reticulo-endothelial system, deviation from theory of observed efficiencies at low perfusion rates may be caused by a decrease in open channels in the hepatic vascular bed, and analysis of chromic phosphate extraction efficiency in relation to total hepatic blood flow may be a measure of hepatic vascular cross section. (auth)

CHEMISTRY

5247 NP-5685

Stanford Research Inst., Calif.
THE THERMODYNAMIC PROPERTIES OF MOLTEN SALTS. QUARTERLY PROGRESS REPORT NO. 3 FOR DECEMBER 1, 1954 TO FEBRUARY 28, 1955. A. P. Brady, J. K. Clauss, and O. E. Myers. Apr. 1, 1955. 16p. Contract AF33(616)-2558.

Commercial MoF_6 was purified by fractional distillation. Attempts to prepare MoF_3 from MoBr_3 were unsuccessful. The work on a nickel calorimeter was continued. A recording precision microvolt potentiometer was placed in operation. (For preceding period see NP-5542.) (C.W.H.)

5248 OSR-TN-55-159

Princeton Univ., N. J. Forrestal Research Center
SURFACE ACTIVITY METHODS FOR THE DETERMINATION OF DIFFUSION COEFFICIENTS IN SOLIDS. METALLURGY REPORT NO. 2. R. H. Condit and C. E. Birchenall. Apr. 1955. 20p. Contract AF 18(600)-967.

The surface activity method of determining diffusion coefficients in solids is examined with emphasis on the proper treatment of the radiation absorption problem under a variety of geometrical conditions which may be employed in diffusion measurements. The theoretical equations have been tested for several geometries with the Mn K_α radiation from Fe^{55} sources. (auth)

5249 UCRL-4504

California. Univ., Livermore. Radiation Lab.
REACTIONS OF DIBORANE WITH AMMONIA AND THE STRUCTURE OF THE "DIAMMONIATE OF DIBORANE." William L. Jolly. May 16, 1955. 11p. Contract W-7405-eng-48.

Dilute solutions of diborane in ammonia at -64°C react with sodium (in excess) to evolve approximately 1.3 equivalents of hydrogen per mole of diborane. Experiments with deuterodiborane show that the entire 1.3 equivalents of hydrogen originate from the ammonia, indicating that the borine groups do not ammonolyze under these conditions. This behavior has been explained by postulating the following structure for the "diammoniate of diborane" in "mis-treated" liquid ammonia solutions: $(\text{NH}_4^+)_2 [\text{B}(\text{BH}_3)_2]$. Concentrated solutions of diborane in ammonia decompose above 0°C to give the ammoniate of aminodiborane. (auth)

5250 WIN-19

National Lead Co., Inc. Raw Materials Development Lab., Winchester, Mass.
DESCRIPTION OF ALKALINE LEACH PILOT PLANT AT GRAND JUNCTION, COLORADO. J. Q. Jones, D. O. Skiles, and G. Winslow. June 24, 1955. 13p. Contract AT(49-6)-924.

The pilot plant facilities at Grand Junction, Colorado,

for testing the amenability of domestic uranium ores to the carbonate leaching process are described. The chemistry of uranium dissolution in carbonate solutions and its precipitation with NaOH is discussed briefly. (auth)

5251 AEC-tr-2171

METAL DEPOSITS FROM AMALGAM. I. DETERMINATION OF THE EQUILIBRIUM DIAGRAM OF THE NaOH-NaBr-NaI SYSTEM. T. S. Okada, S. R. Yoshizawa, and N. Y. Watanabe. Translated from *J. Chem. Soc. Japan Ind. Chem. Sect.* 56, 79-81(1953). 8p.

A study was made of the equilibrium diagram for the electrolytic system necessary for the production of metallic Na from Na amalgam by electrolysis of fused salts. (auth)

5252

DIFFUSION OF ZINC IN CRYSTALLINE ZINC OXIDE. E. A. Secco and W. J. Moore (Indiana Univ., Bloomington). *J. Chem. Phys.* 23, 1170-1(1955) June.

The diffusion of Zn in crystals of ZnO has been measured from 900 to 1025°C in an atmosphere of Zn vapor. At 1 atm Zn pressure, it was found that $D = 4.8 \exp(-73 \text{ kcal/RT}) \text{ cm}^2 \text{ sec}^{-1}$. (auth)

5253

EXCHANGE OF CHLORINE IN AQUEOUS SYSTEMS CONTAINING CHLORIDE AND TETRACHLOROPLATINATE(II). LeRoy F. Grantham, Thomas S. Elleman, and Don S. Martin, Jr. (Iowa State Coll., Ames). *J. Am. Chem. Soc.* 77, 2965-71 (1955) June 5.

The kinetics of exchange of chlorine has been measured in aqueous solutions containing Cl^- , $[\text{PtCl}_4]^{2-}$, and $[\text{PtCl}_3(\text{H}_2\text{O})]^-$, by the use of Cl^{36} . Exchange occurred by means of a reversible aquation process involving $[\text{PtCl}_4]^{2-}$. (auth)

5254

ISOTOPIC EXCHANGE OF MANGANESE DIOXIDE WITH OXYGEN AND WATER VAPOR. L. A. Kasatkina and G. K. Borezkov (Mendeleev Chemico-Technological Inst., Moscow) *Zhur. Fiz. Khim.* 29, 455-62(1955) Mar. (In Russian)

Isotopic exchange was measured by variations in O^{18} concentration between active MnO_2 and O_2 at 200 to 350°C active MnO_2 and water vapor at 200 to 300°C, and $\beta\text{-MnO}_2$ and O_2 at 350 to 400°C. (G.Y.)

5255

INVESTIGATION OF REACTION EQUILIBRIUM IN THE REDUCTION OF TiO_2 BY CARBON AT HIGH TEMPERATURES. I. V. S. Kutsev and B. F. Ormont (Karpov Physico-Chemical Research Inst., Moscow). *Zhur. Fiz. Khim.* 29, 597-601 (1955) Apr. (In Russian)

ANALYTICAL PROCEDURES

5256 LA-1886

Los Alamos Scientific Lab., N. Mex.

THE DETERMINATION OF MERCURY BY SINGLE EXTRACTION. Evan E. Campbell and Billye Marie Head. Mar. 1955. 22p. Contract W-7405-eng-36.

A colorimetric method for the determination of Hg in urine has been developed. First, the Hg in the urine is oxidized by a $\text{KMnO}_4\text{-H}_2\text{SO}_4$ mixture and this is followed by a single extraction of the oxidized Hg using dithizone. Absorption measurements were made at 490 mμ. Interfering ions are minimized by proper pH control and versene complexing. (C.W.H.)

5257 LA-1904

Los Alamos Scientific Lab., N. Mex.

THE DETERMINATION OF POLONIUM IN URINE. M. Chain Robbins, Bernard C. Eutsler, and Morris F. Milligan. Apr. 1955. 18p. Contract W-7405-eng-36.

A simple rapid method for the determination of polonium in urine is described. The polonium deposits electrochemically onto a nickel disk from an acidified urine solution. The extraction of the polonium is quantitative, depending upon storage conditions of the urine and sample size as well as extraction technique. Polonium recoveries of $98 \pm 10\%$ are attainable at all concentration levels from 10 to 1,000 d/m/l of urine. Investigations of effects upon recovery of the polonium have been made with regard to sample volume, plate material, storage time and temperature, addition of sulfamic acid, plating temperature, specific gravity of the urine, and the interference of certain metal ions. (auth)

5258 ORNL-1827

Oak Ridge National Lab., Tenn.

APPLICATION OF THE VOLMARD TITRATION TO THE 2-ETHYL-1-HEXANOL SEPARATION METHOD FOR THE DETERMINATION OF LITHIUM. J. C. White and G. Goldberg. June 27, 1955. 13p. Contract W-7405-eng-26.

The Volhard titration method for the determination of chloride has successfully been applied to the determination of lithium as lithium chloride following its separation from sodium and potassium chlorides by extraction with 2-ethyl-1-hexanol. The titration of chloride is conducted directly in the alcoholic phase after a single extraction. The method is applicable in the range of 1 to 50 mg of lithium; the total quantity of chloride taken should not exceed 500 mg. (auth)

5259 ORNL-1899

Oak Ridge National Lab., Tenn.

THE DETERMINATION OF WATER BY COULOMETRIC TITRATION. A. S. Meyer, Jr. and C. M. Boyd. May 20, 1955. 25p. Contract W-7405-eng-26.

A coulometric method has been developed for the determination of traces of water in organic solvents. The water is titrated by Karl Fischer reagent which is produced by the electrolytic generation of iodine in a solution of the depleted reagent in ethylene glycol. The stoichiometry of the reaction corresponds to one mole of iodine per mole of water, or 10.7 coulombs of electrical current per mg of water. The effect of side reactions which consume iodine is eliminated by the use of a supplementary generating current which is adjusted to maintain the solution at the end point before the addition of the sample. The method has been applied to the determination of water in propane-diamine, 1-2 by neutralizing the strong amine with a solution of salicylic acid in ethylene glycol, rather than acetic acid in methanol, to reduce the rate of esterification. Concentrations of water as low as 50 μg/ml have been determined in one-ml samples of propane-diamine, 1-2, while concentrations of 5 μg/ml have been measured in other solvents. The absolute standard deviation of the titration is approximately 2 μg of water. For samples which contain concentrations of water in excess of 0.1% the coefficient of variation is less than 2%. (auth)

5260 ORNL-1909

Oak Ridge National Lab., Tenn.

DIFFERENTIAL SPECTROPHOTOMETRIC DETERMINA-

TION OF BERYLLIUM. J. C. White, A. S. Meyer, Jr., and D. L. Manning. June 6, 1955. 20p. Contract W-7405-eng-26.

Differential spectrophotometry was applied to the determination of beryllium as the p-nitrobenzeneazoörcinol complex in basic solution. The absorbance of the complex is measured against a reference standard which contains 1.0 mg of beryllium per 100 ml of solution. The coefficient of variation of the method is less than 1% on duplicate determinations. The method is essentially free from interferences and is applicable to the determination of beryllium in the presence of moderate amounts of uranium and aluminum. Relatively large amounts of fluoride can be tolerated without interference. (auth)

5261 USNRDL-TR-40

Naval Radiological Defense Lab., San Francisco.

QUANTITATIVE PAPER CHROMATOGRAPHIC DETERMINATION OF THE FREE AMINO ACIDS AND RELATED COMPOUNDS IN THE URINE AND TISSUES OF THE RAT. R. E. Kay, D. C. Harris, and C. Entenman. Mar. 10, 1955. 34p.

The method reported utilizes one-dimensional paper chromatography followed by color development with ninhydrin for the determination of taurine, cysteic acid, lysine, arginine, glycine plus serine, threonine, alanine, methionine, valine, leucines, citrulline, tyrosine, glutamic acid, aspartic acid, and glutamine in urine and tissue preparations. The determinations are made as follows: the unknown mixture was resolved, the paper dried, sprayed with an alkaline alcoholic solution of ninhydrin, and heated to develop the ninhydrin color. Quantitative determinations of the ninhydrin-reactive compounds were made by cutting the colored areas from the paper and eluting the color with 71% ethanol. The absorbance of the eluate was determined by means of a spectrophotometer and the concentration of the ninhydrin-reactive compound obtained from the absorbance. The results of urine, plasma, and liver analyses are also presented. Duplicate determinations were shown to agree within 4% at the 2 μ g level. (auth)

5262

ANALYSIS OF FLUORINATED POLYPHENYLS BY MASS SPECTROMETER. Paul Bradt and Fred L. Mohler (National Bureau of Standards, Washington, D. C.). Anal. Chem. 27, 875-7(1955) June.

A mass spectrometric method has been used to investigate the molecular weight and chemical composition of some fluorinated polyphenyls. The polymers were evaporated from a tube furnace directly into the ionization chamber of a mass spectrometer and mass spectra recorded as the furnace temperature was increased step by step. Mass spectra of polymers made from p-dibromotetrafluorobenzene showed molecules of formula $(C_6F_4)_nBr_2$ with n ranging from 3 to 6. Polymers made from the diiodo compound gave ions with as many as eleven phenylene rings with or without one or two iodine atoms attached to the chain. Molecule ions are predominant in these mass spectra; this simplifies the interpretation of results in terms of molecular weight distribution. (auth)

5263

DIRECT SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN AQUEOUS SOLUTIONS. R. G. Canning and P. Dixon (Geological Survey Labs., South Australia). Anal. Chem. 27, 877-80(1955) June.

A rapid, direct method was required for estimating ura-

nium in sulfate solutions containing uranium, vanadium, chromium, and rare earths in concentrations of 1 to 2 g/l of the respective oxides, titanium up to 10 g/l of titanium dioxide, and ferrous and ferric iron up to a total of 40 g/l of ferric oxide. Existing chemical methods were too lengthy, while rapid fluorimetric and colorimetric methods were not sufficiently precise. A two-component spectrophotometric method was developed, utilizing the reduction of uranium and vanadium by ferrous sulfate in 40 vol. % phosphoric acid solution. Estimations may be completed in 1 hr with reasonable precision. Using a Hilger Uvispek spectrophotometer, standard deviations in precision of $\pm 1\%$ were obtained over the range 0.5 to 5.0 g/l of uranium oxide in the presence of other components in the concentrations mentioned above. Standard deviations in accuracy were better than 2% over the same range. Concurrent with the determination of uranium, a less accurate estimation of vanadium is possible. (auth)

5264

POLAROGRAPHY WITH PLATINUM MICROELECTRODES IN FUSED SALTS. Edward D. Black and Thomas De Vries (Purdue Univ., Lafayette, Ind.). Anal. Chem. 27, 906-9(1955) June.

Conditions for obtaining polarograms in fused salts with platinum microelectrodes were established. Automatic recording was employed in most experiments. In the eutectic mixture, lithium chloride-potassium chloride between 380 and 450° C., waves were obtained with a microcathode and a platinum coil anode. The theoretical shape of the cobalt and nickel waves was expressible by a linear relation between $\log(i_d - i)$ and applied potential. A linear relation between wave height and mole fraction was obtained for dilute solutions of cadmium chloride, cobalt chloride, nickel chloride, lead chloride, zinc chloride, and potassium chromate in the alkali halide melt. Half-wave and decomposition potentials of cobalt chloride and nickel chloride shifted in the expected direction and magnitude. The effect of variation in polarization rate, area of microelectrode, speed of rotation of the electrode, and temperature was examined with respect to polarograms of nickel chloride. The temperature coefficient and energy of activation for the limiting diffusion currents of nickel have been determined. In a melt of lithium nitrate, sodium nitrate, and potassium nitrate as solvent, with rotating spherical microcathodes of platinum or silver, a linear relationship between wave height and concentration of copper sulfate was observed. (auth)

5265

DETERMINATION OF SMALL AND LARGE AMOUNTS OF FLUORINE IN ROCKS. F. S. Grimaldi, Blanch Ingram, and Frank Cuttitta (U. S. Geological Survey, Washington, D. C.). Anal. Chem. 27, 918-21(1955) June.

Gelatinous silica and aluminum ions retard the distillation of fluorine in the Willard and Winter distillation method. A generally applicable, simple method for the determination of fluorine in rocks containing aluminum or silicon or both as major constituents was desired. In the procedure developed, the sample is fused with a mixture of sodium carbonate and zinc oxide, leached with water, and filtered. The residue is granular and retains nearly all of the silica. The fluorine in the filtrate is distilled directly from a perchloric acid-phosphoric acid mixture. Phosphoric acid permits the quantitative distillation of fluorine in the presence of much aluminum at the usual distillation temperature and without the collection of large volumes of distillate. The fluorine is de-

terminated either by microtitration with thorium nitrate or colorimetrically with thoron. The procedure is rapid and has yielded excellent results on silicate rocks and on samples from the aluminum phosphate (leached) zone of the Florida phosphate deposits. (auth)

5266

DETERMINATION OF URANIUM IN URANIUM CONCENTRATES. USE OF ETHYL ACETATE. R. J. Guest and J. Zimmerman (Department of Mines and Technical Surveys, Ottawa, Canada). *Anal. Chem.* 27, 931-6(1955) June.

A method is described for the determination of uranium in high-grade uranium material. Uranium is separated from contaminants by means of an ethyl acetate extraction using aluminum nitrate as a salting agent. After the uranium has been stripped from the ethyl acetate layer by means of water, colorimetric determination of the uranium is carried out by the sodium hydroxide-hydrogen peroxide method. The procedure is accurate, rapid, and easily adaptable to routine work. (auth)

5267

RADIOISOTOPIC STUDY OF URANIUM SEPARATIONS. SEPARATIONS BY FILTER-PAPER PARTITION CHROMATOGRAPHY WITH 2-METHYLTETRAHYDROFURAN. Helen P. Raaen and P. F. Thomason (Oak Ridge National Lab., Tenn.). *Anal. Chem.* 27, 936-44(1955) June.

Radioisotopes were used to study the microseparation of uranium (VI) from 31 metals (32 radioisotopes) by filter-paper partition chromatography with 2-methyltetrahydrofuran. Autoradiography of the chromatograms established the efficiencies of the separations. The sorption gradient of the separated uranium²³³ was determined by α -count measurements of the chromatograms; the quantitative removal of approximately 0.5 γ of uranium²³³ from the paper strip was demonstrated by the same technique. As little as 0.02 γ of uranium²³³ was chromatographed successfully. Maximum condensation of the uranium²³³ band was effected by a 1.75-hour elution with water-saturated (at 25° C.) 2-methyltetrahydrofuran that contained 2.5% (v./v.) concentrated nitric acid. The average R_f value for uranium²³³ was 0.95. Of the radioisotopes studied, ruthenium¹⁰⁶-rhodium¹⁰⁶ and tungsten¹⁸⁵ were not completely separated from uranium²³³. The results for tin¹¹³ and antimony¹²⁴ were not conclusive. The behavior of mercury²⁰³ was similar to that of uranium²³³. (auth)

5268

SEPARATION AND DETERMINATION OF THORIUM AND ALUMINUM. Charles V. Banks and R. E. Edwards (Iowa State Coll., Ames). *Anal. Chem.* 27, 947-9(1955) June.

Methods are presented which are applicable to the accurate analysis of an occasional thorium-aluminum mixture or to the rapid and accurate analysis of many thorium-aluminum mixtures on a routine basis. The latter method involves a combination of a modified mesityl oxide extraction of thorium with a unique modification of the usual spectrophotometric titration. This unique modification eliminates the construction of all but the initial calibration curve, requires only one standard solution, only one initial pH adjustment, and the measurement of one absorbance for each thorium determination. This modification would seem to be generally useful in adapting similar spectrophotometric titrations to a routine basis. (auth)

5269

FLUORIMETRIC DETERMINATIONS OF ALUMINUM AND GALLIUM IN MIXTURES OF THEIR OXINATES. Justin W.

Collat and L. B. Rogers (Massachusetts Inst. of Tech., Cambridge). *Anal. Chem.* 27, 961-5(1955) June.

This study was designed to test the feasibility of determining two substances in a mixture, when each has nearly the same fluorescence spectrum, by taking advantage of the difference in their sensitivities to different wave lengths of exciting radiation. A Beckman DU spectrophotometer was modified to enable one to determine the fluorescence spectra of the individual components, while another was employed to provide monochromatic exciting radiation. Aluminum and gallium oxinates, which have nearly the same fluorescence spectra in chloroform, have been analyzed with moderate success by this technique. Determination of mixtures of substances having different fluorescence spectra can probably be facilitated by taking advantage of this additional variable. (auth)

5270

VOLUMETRIC DETERMINATION OF FLUORINE INVOLVING DISTILLATION FROM A SULFURIC ACID SOLUTION. Oliver D. Smith and Thomas D. Parks (Stanford Research Inst., Calif.). *Anal. Chem.* 27, 998-1000(1955) June.

The use of sulfuric acid and distillation at 150° C. in the Willard and Winter method decreases the retarding influence of aluminum and silicon upon the volatilization of fluorides in analysis of vegetation, soils, and particulate materials. A modified steam tube minimizes contamination of the distillate. (auth)

5271

DETERMINATION OF THORIUM BY FLUORESCENT X-RAY SPECTROMETRY. Isidore Adler and J. M. Axelrod (U. S. Geological Survey, Washington, D. C.). *Anal. Chem.* 27, 1002-3(1955) June.

A fluorescent x-ray spectrographic method for the determination of thorium in rock samples uses thallium as an internal standard. Measurements are made with a two-channel spectrometer equipped with quartz ($d = 1.817 \text{ \AA}$) analyzing crystals. Particle-size effects are minimized by grinding the sample components with a mixture of silicon carbide and aluminum and then briquetting. Analyses of 17 samples showed that for the 16 samples containing over 0.7% thorium the average error, based on chemical results, is 4.7% and the maximum error, 9.5%. Because of limitations of instrumentation, 0.2% thorium is considered the lower limit of detection. An analysis can be made in about an hour. (auth)

5272

QUANTITATIVE SPECTROGRAPHIC ANALYSIS OF RARE EARTH ELEMENTS. DETERMINATION OF HOLMIUM, ERBIUM, YTTRIUM, AND TERBIUM IN DYSPROSIUM. DETERMINATION OF YTTRIUM, DYSPROSIUM, AND ERBIUM IN HOLMIUM. DETERMINATION OF YTTRIUM, DYSPROSIUM, HOLMIUM, THULIUM, AND YTTERBIUM IN ERBIUM. Velmer A. Fassel, Beverly Quinney, Laird C. Krotz, and Carl F. Lentz (Iowa State Coll., Ames). *Anal. Chem.* 27, 1010-14(1955) June.

Emission spectrometric methods are described for quantitative determination of rare earths commonly associated with purified dysprosium, holmium, and erbium. The concentration range from the detection limit up to 1% is covered by these methods. The procedures are based on direct current carbon arc excitation of rare earth oxide-graphite mixtures. The unique similarity in excitation behavior among many of the rare earths provides a high degree of internal standardization of variables inherent in direct current carbon arc

excitation. An unusual example of self reversal in the Ho 3456.00 Å line is noted. (auth)

5273

POLAROGRAPHIC DETERMINATION OF LEAD IN BERYLLIUM. R. W. Bane (Argonne National Lab., Lemont, Ill.). *Anal. Chem.* 27, 1022-4(1955) June.

A rapid polarographic method for the determination of small amounts of lead in beryllium metal is described. No separations are necessary. A hydrochloric acid solution of beryllium acts as the supporting electrolyte. In the range of 150 to 800 ppm of lead the precision is 10% or better. The simple procedure is readily adaptable for routine use. Evidence for the feasibility of the simultaneous determination of lead, cadmium, and zinc is presented. (auth)

5274

THE DETERMINATION OF NIOBIUM OR TANTALUM IN URANIUM AND ZIRCONIUM-BASE ALLOYS. G. W. C. Milner, G. A. Barnett, and A. A. Smales (Atomic Energy Research Establishment, Harwell, Berks, England). *Analyst* 80, 380-90(1955) May.

A new gravimetric method is presented for the determination of Nb or Ta in U or Zr-base alloys. Separation of the Nb or Ta from the base alloys is achieved by a fluoride-hexone extraction procedure. (C.W.H.)

5275

ESTIMATION OF THORIUM BY ORGANIC REAGENTS. PART VI. USE OF SOME IODOBENZOIC ACIDS. Sachindra Kumar Datta and Gurupada Banerjee (Darjeeling Government Coll., India). *J. Indian Chem. Soc.* 32, 167-72(1955) Mar.

A procedure for the estimation of thorium and its separation from cerite earths present in monazite, with the use of substituted iodobenzoic acids is described. (C.W.H.)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

5276 OSR-TN-55-103

Pennsylvania. Univ., Philadelphia.

THE CHANGE OF LENGTH OF IONIC CRYSTALS DUE TO X-RAY IRRADIATION. TECHNICAL REPORT NO. 3.

Lan-Ying Lin. June 1955. 79p. Contract AF18(600)-561.

Potassium chloride and sodium chloride crystals, about 12 mm × 8 mm × 1.5 mm, were irradiated at room temperature both in air and in helium atmosphere for times up to three hours. A series of measurements were carried out during and after irradiation for various lengths of time. The relationship between the relative expansion of crystal and the density of F-centers was found to be linear. It was also observed that the relative expansion of the crystal does not depend on the dimensions of the colored part of the crystal, and a short time lag occurs between the start of the irradiation and the initial expansion of the crystal. In bleached crystals the crystals neither contracted nor expanded when the density of F-centers was reduced from about 10^{17} cm^{-3} to less than 10^{15} cm^{-3} . (C.H.)

5277

FREQUENCY SPECTRA OF FREE LATTICES AND PARTICLE SIZE EFFECTS ON THE HEAT CAPACITY OF SOLIDS. D. Patterson (National Research Labs., Ottawa, Canada). *Can. J. Chem.* 33, 1079-87(1955) June.

The effect of particle size on the heat capacity of solids has been investigated using lattices with free boundaries as models. A monatomic lattice shows a low temperature effect associated with the acoustic modes. This can be compared

with results obtained from a continuum model. With a diatomic lattice, however, an effect is also associated with the optical modes and is apparent at higher temperatures. The possibility that this latter effect can explain some recent experimental results is examined. (auth)

5278

STRUCTURE OF NITRATE COMPOUNDS OF RARE EARTH ELEMENTS. V. I. Iveronova, V. P. Tarasova, Z. K. Zolina, G. V. Markhasin, and I. M. Sukhodreva (Moscow State Univ.). *Zhur. Fiz. Khim.* 29, 314-15(1955) Feb. (In Russian)

Triclinic lattice constants for $\text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$, $\text{Ce}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$, and $\text{Sm}(\text{NO}_3)_3 \cdot n\text{H}_2\text{O}$ are presented and the structure of these and nitrates of other rare earths are discussed. (G.Y.)

DEUTERIUM AND DEUTERIUM COMPOUNDS

5279 NBS-3676

National Bureau of Standards, Washington, D. C.

A REVIEW OF THE REACTION KINETICS OF DEUTERIUM COMPOUNDS. II. DECOMPOSITION REACTIONS OF ORGANIC COMPOUNDS. Lawrence M. Brown and Abraham S. Friedman. Oct. 15, 1954. 119p.

The kinetics of decomposition reactions of organic deuterium compounds are reviewed for the period 1932 to 1953. The following classes of compounds are covered: hydrocarbons, aldehydes, ketones, peroxides, acids, azo compounds, and amines. Also covered are the compounds: diacetone alcohol, 2-pentachlorosulfite, chloroform, benzoquinhydrone, d-sucrose, and d-glucose. The review treats both thermal and photochemical decompositions in the liquid and gas phases, and contains tabular summaries of the experimental data for most of the reactions discussed. (For preceding report in series see NBS-3091.) (auth)

5280 UCRL-4496

California. Univ., Livermore. Radiation Lab.

PROGRESS REPORT ON LOADING OF TITANIUM WITH DEUTERIUM. James W. Ruff. May 5, 1955. 7p.

Contract W-7405-eng-48.

A high vacuum system that permitted the loading of titanium with deuterium gas of high purity was designed and built. Heating at temperatures of 1100 to 1125°C and pressures of 5×10^{-6} mm Hg for approximately one hour assured maximum loads of 424 cc D/g Ti. (G.L.S.)

5281

ON THE DISTRIBUTION OF DEUTERIUM DURING ISOTOPIC EXCHANGE WITH HYDROGEN. Ya. M. Varshavskii and S. E. Vaisbery (Karpov Physico-Chemical Inst., Moscow). *Zhur. Fiz. Khim.* 29, 523-32(1955) Mar. (In Russian)

Factors of the distribution-coefficient functions for D between two-component systems of all combinations of H_2 , CH_4 , C_2H_6 , C_2H_4 , C_6H_6 , NH_3 , H_2O , HF , PH_3 , H_2S , HCl , AsH_3 , H_2Se , HBr , and HI are evaluated in relation to the spectra of the compounds and the position in the periodic table of the component elements. (G.Y.)

FLUORINE AND FLUORINE COMPOUNDS

5282 AEC-tr-2176

ORGANIC FLUORINE COMPOUNDS. Gyorgy Olah.

Translated from *Magyar Kém. Lapja* 5, 343-50(1950). 30p.

The preparation and properties of several classes of fluoroorganic compounds are outlined. Theoretical aspects of the C-F bond are discussed. Practical applica-

tions of specific fluorine compounds are mentioned. A brief note on nomenclature is included. (C.W.H.)

GRAPHITE

5283

GRAPHITES. OXIDATION RATES ESTABLISHED IN RECENT NBS STUDIES. *Iron Age* 175, No. 23, 115-17(1955) June 9.

The establishment of a set of numerical constants for the oxidation rates of natural graphites in oxidizing atmospheres indicates that coarser sizes of graphites having a graphite content of about 85% are difficult to oxidize either in air or in a stream of oxygen at 400°C. When fine and coarse sizes are combined as in finished and unglazed crucible bodies, a slow oxidation begins at 400°C and the rate increases at higher temperatures with a definite deterioration of the body. (J.E.D.)

LABORATORIES AND EQUIPMENT

5284 HW-26500

Hanford Atomic Products Operation, Richland, Wash. A SECTIONAL GLOVED BOX. D. C. Kaulitz and W. E. Roake. Feb. 8, 1955. 17p. Contract W-31-109-Eng-52.

The design and construction of a sectional glove box are described. The basic body section consists of a three-foot-long open-ended structure. (C.W.H.)

5285 ORNL-1742

Oak Ridge National Lab., Tenn.

RADIO-FREQUENCY OSCILLATORS FOR DETERMINATION OF ALKALI. R. W. Stelzner and M. T. Kelley—H. P. Raaen, ed. June 27, 1955. 47p. Contract W-7405-eng-26.

The development and evaluation of an instrument for the determination of high concentrations (greater than 0.1 M) of alkali in aqueous solution are described. The design of the instrument is based upon the loading of a radio-frequency oscillator. This instrument is useful in the range of 0 to 3.0 M potassium hydroxide solution. (auth)

5286

DISPENSER FOR RADIOACTIVE SOLUTIONS. Norman S. Radin (V. A. Research Hospital, Chicago and Northwestern Univ., Evanston, Ill.). *Nucleonics* 13, No. 6, 92-6(1955) June.

An apparatus has been designed to dispense known volumes of liquid from a reservoir by controlling the duration of flow. A large batch of diluted radioisotope can be made up, calibrated once, and dispensed from a 500-ml Pyrex aspirator bottle. The duration of flow is controlled by a solenoid operated by an electric timer clock. The liquid flow rate is independent of the amount of liquid in the bottle. Test runs were made with radioactive sodium iodide solution, and data are presented. (M.P.G.)

RADIATION CHEMISTRY

5287 AECU-3036

University of Notre Dame, South Bend, Ind.

SUMMARY OF PROCEEDINGS OF AN INFORMAL DISCUSSION ON THE RADIATION CHEMISTRY OF WATER, MARCH 30-APRIL 2, 1955. A. Kuppermann, S. Lipsky, and L. Monchick, eds. 33p. Contract [AT(11-1)-38].

Recent developments and research in the radiation chemistry of water are outlined. Discussions of the varia-

tion of G values with incident radiation, theory of diffusion-recombination processes, paramagnetic resonance absorption of irradiated substances, and production of free radicals in gaseous discharges are included. (C.W.H.)

5288

CHEMICAL EFFECTS OF THE $C^{12}(\gamma,n)C^{11}$ REACTION IN ANHYDROUS SODIUM CARBONATE. L. J. Sharman and K. J. McCallum (Univ. of Saskatchewan, Saskatoon, Canada). *J. Am. Chem. Soc.* 77, 2989-92(1955) June 5.

When sodium carbonate crystals, which have been exposed to γ radiation from a betatron operating at a peak energy of 23 Mev, are dissolved in water, C^{11} is found to be present in carbonate, carbon monoxide, formic acid, oxalic acid, glyoxylic acid and glycolic acid. The distribution of C^{11} activity between these compounds has been measured, and found to be independent of twofold variations in the total γ -ray dose or in the dose rate. The distribution is also independent of the pH of the solution in which the crystals are dissolved. The distribution of the C^{11} activity between the two positions of the glyoxylic and glycolic acid molecule has been determined. If the crystals are heated at a series of increasing temperatures before dissolving, the percentage of the C^{11} present as glyoxylic acid, glycolic acid and oxalic acid decreases, each at a different temperature, and the corresponding activity appears instead as carbonate. A mechanism is suggested to account for the experimental results. (auth)

RADIATION EFFECTS

5289 UCRL-2949

California. Univ., Berkeley. Radiation Lab.

THIOCTIC- S^{35}_2 ACID: SYNTHESIS AND RADIATION DECOMPOSITION. Patricia T. Adams. Apr. 8, 1955. 6p. Contract W-7405-eng-48.

Thioctic- S^{35}_2 acid has been prepared with a specific activity of 1 μ c/mg in 10% to 15% yield from amorphous sulfur-35. In a preparation using 200 mc of S^{35} (specific activity of product, 200 μ c/mg) no crystalline product could be isolated. Preliminary investigation into the extent of the radiation decomposition of thioctic acid has been made. (auth)

5290

X-RAY DOSIMETRY BY RADIOLYSIS OF SOME ORGANIC SOLUTIONS. II. SENSITIZED INDICATOR SOLUTIONS. George L. Clark and Paul E. Blerstedt, Jr. (Univ. of Illinois, Urbana). *Radiation Research* 2, 295-305(1955) June.

The radiosensitivity of aromatic derivatives containing azo groups known for indicator properties which might prove suitable for use as radiation dosimeters was investigated. Results are presented from studies on the effects of x rays on solutions of 2-hydroxy-4-nitrophenylazo- β -naphthol and of resazurin (diazoresorcinol) individually and in combination dissolved in ethanol, chloroform, or carbon tetrachloride. (C.H.)

5291

THE MECHANISM OF THE EFFECT OF X RAYS AND ULTRAVIOLET RAYS ON AQUEOUS SOLUTION OF ALBUMIN AND THYMONUCLEIC ACID. N. Koyenuma. *Strahlentherapie* 96, 599-617(1955) Apr. (In German)

The author used potentiometer and polarography for the purpose of investigating the reaction to roentgen and ultraviolet rays of watery solutions of protein, cystine and thymonucleic acid. He then compared the sensitivity of the different solutions to these radiations. The observed acidulation

is due to the formation of H_2O_2 on the one side and the production of activated O_3 on the other. The ultraviolet light quanta are acting directly on the dissolved substance while the roentgen quanta are primarily and mainly attacking the dissolvent. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

5292 AEC-tr-2168

ON THE CRYSTALLINE STRUCTURE OF COMPOUNDS OF RARE EARTHS AND METALLOIDS OF GROUP V—NITRIDES OF LANTHANUM, CERIUM, AND PRASEODYMIUM. PAPER NO. II. (Sulla Struttura Cristallina Dei Composti Delle Terre Rare Con i Metalloidi Del V Gruppo—Azoturi Di Lantanio, Cerio e Praseodimio. Nota II). A. Iandelli and E. Botti. Translated from *Atti accad. Lincei, Classe sci. fis., mat. nat.* 25, 129-32(1937). 3p.

Nitrides of Ce, Pr, and La were prepared by the Muthmann method and were studied by means of powder photograms. A NaCl-type crystal structure was proposed for these compounds. (C.W.H.)

5293 AEC-tr-2169

ON THE CRYSTALLINE STRUCTURE OF COMPOUNDS OF RARE EARTHS AND METALLOIDS OF GROUP V—ARSENIDES AND ANTIMONIDES OF LANTHANUM, CERIUM, AND PRASEODYMIUM. PAPER NO. III. (Sulla Struttura Cristallina Dei Composti Delle Terre Rare Con i Metalloidi Del V Gruppo—Arseniuri e Antimoniuri Di Lantanio, Cerio e Praseodimio. Nota III). A. Iandelli and E. Botti. Translated from *Atti accad. Lincei, Classe sci. fis., mat. nat.* 25, 498-502(1938). 4p.

The arsenides and antimonides of La, Ce, and Pr were prepared and were examined by means of powder photograms. NaCl-type structures were postulated for these compounds. (C.W.H.)

5294 AEC-tr-2170

ON THE CRYSTALLINE STRUCTURE OF COMPOUNDS OF RARE AND METALLOIDS OF GROUP V—NEODYMIUM COMPOUNDS. PAPER NO. IV—(Sulla Struttura Cristallina Dei Composti Delle Terre Rare Con i Metalloidi Del V Gruppo—Composti Del Neodimio. Nota IV). A. Iandelli and E. Botti. Translated from *Atti accad. Lincei, Classe sci. fis., mat. nat.* 25, 638-40(1938). 3p.

The nitride, phosphide, arsenide, and antimonide of neodymium were prepared and were studied by means of powder photograms. NaCl-type crystal structures were postulated for these compounds. (C.W.H.)

5295

THE HEATS OF REACTION OF THE DICHLORIDES OF SAMARIUM AND YTTERBIUM WITH HYDROCHLORIC ACID. A MICROCALORIMETER. G. R. Machlan, C. T. Stubblefield, and L. Eyring (State Univ. of Iowa, Iowa City). *J. Am. Chem. Soc.* 77, 2975-8(1955) June 5.

The heats of reaction at 25° of $SmCl_2$ and $YbCl_2$ with hydrogen-saturated 6.00M HCl were found to be -42.2 ± 0.2 and -41.2 ± 0.2 kcal/mole, respectively. These values were combined with other thermochemical data to obtain the corresponding heats of formation of the dichlorides of -195.6 ± 1.0 and -184.5 ± 1.7 kcal/mole, respectively. The heats of reaction were measured in an adiabatic microcalorimeter which was constructed for that purpose. The description and characteristics of the instrument are given. (auth)

5296

ON THE REACTION OF EUROPIUM DICHLORIDE WITH

SOLUTIONS OF HYDROCHLORIC ACID. C. T. Stubblefield and L. Eyring (State Univ. of Iowa, Iowa City). *J. Am. Chem. Soc.* 77, 3004-5(1955) June 5.

The reactions of $EuCl_2$ with various concentrations of HCl saturated with H_2 , O_2 , or air have been investigated. Results indicate an extreme sensitivity of the reaction to small variations in the O_2 concentration. (C.W.H.)

SEPARATION PROCEDURES

5297 BMI-282

Battelle Memorial Inst., Columbus, Ohio.
THE AMMONIUM CARBONATE PRESSURE LEACHING OF URANIUM ORES PROPOSED AS FEED TO THE PILOT PLANT AT GRAND JUNCTION, COLORADO. PROGRESS REPORT [NO. 1]. C. M. Wheeler, B. G. Langston, and F. M. Stephens, Jr. June 15, 1955. 27p. Contract AT(49-6)-921.

An integrated plant has been constructed to evaluate the amenability of three ores to an ammonium carbonate pressure leach for extraction of the uranium. The continuous leaching system consists of five towers which are operated under pressure. Operation of the plant with Black Limestone ore as a feed has given extractions ranging from 92 to 93% of the uranium. To obtain these extractions, a temperature of 225°F, a pressure of 90 psi, a retention time of about 3 hrs and a leach solution concentration of 10% ammonium carbonate and 2% ammonium bicarbonate were required. A continuous precipitation tower operating at a feed rate of 10 gallons per hour of pregnant liquor gave a precipitate that assayed 82% of U_3O_8 , which represented a recovery of over 99% of the uranium in the pregnant liquor. (auth)

5298

FACTORS INFLUENCING ION-EXCHANGE EQUILIBRIA IN CONCENTRATED SOLUTIONS: BEHAVIOR OF THE ALKALINE AND EARTH AND ALKALI IONS. R. M. Diamond (Harvard Univ., Cambridge, Mass.). *J. Am. Chem. Soc.* 77, 2798-83(1955) June 5.

A study has been made of the elution behavior of beryllium(II), calcium(II), strontium(II), barium(II), radium(II), sodium(I), rubidium(I), and cesium(I), from a Dowex-50 (10 to 12% DVB) cation-exchange resin column, and of radium(II), strontium(II), cesium(I), and sodium(I) from nominal 2 and 16% DVB sulfonic acid resins with 2.6, 5.5, 8.7, and 12.2M HCl solutions. The results cannot be explained by simple mass-action considerations, but postulation of ion dehydration, resin shrinkage, and non-exchange electrolyte absorption effects makes possible a reasonable interpretation. (auth)

5299

FRACTIONATION OF CHLORINE ISOTOPES BETWEEN GASEOUS CHLORINE AND AQUEOUS CHLORIDE ION. A. C. Rutenberg (Oak Ridge National Lab., Tenn.). *J. Am. Chem. Soc.* 77, 3001-3(1955) June 5.

The equilibrium distribution of chlorine isotopes between gaseous molecular chlorine and chlorine ion in aqueous solution has been investigated. The single-stage fractionation factor was in the range of 1.0024 to 1.006, with Cl^{37} concentrating in the gaseous chlorine (Cl_2) phase. (C.W.H.)

5300

APPLICATION OF PULSATION TO LIQUID-LIQUID EXTRACTION. W. A. Chantry, R. L. Von Berg, and H. F. Wiegandt (Cornell Univ., Ithaca, N. Y.). *Ind. Eng. Chem.* 47, 1153-9(1955) June.

Application of pulsation to a packed column improved the efficiency. The optimum operating conditions of pulse frequency and amplitude at a constant feed rate were determined. The effect of varied feed rates and effect of pulsation on the flooding capacity were established. Very high plate efficiencies were obtained with pulsed sieve-plate columns. (C.W.H.)

5301

POWER REQUIREMENTS FOR PULSE GENERATION IN PULSE COLUMNS. A. Carleton Jealous (Oak Ridge National Lab., Tenn) and Homer F. Johnson (Univ. of Tennessee, Knoxville). *Ind. Eng. Chem.* 47, 1159-66(1955) June.

The power required to pulse a liquid-liquid extraction column is determined by the static head of the liquid system, the acceleration and deceleration forces on the liquid system, and the friction losses. An expression for the theoretical total power that must be applied to the liquid-liquid system by the pulser is derived. Power input data obtained on a 50-ft pulse column 24 inches in diameter are given. (auth)

5302

THE ROLE OF POROSITY IN FILTRATION. PART 2. ANALYTICAL EQUATIONS FOR CONSTANT RATE FILTRATION. F. M. Tiller (Lamar State Coll. of Tech., Beaumont, Tex.). *Chem. Eng. Progr.* 51, 282-90(1955) June.

In Part 1 (*Chem. Eng. Progr.* 49, 467(1953)) graphical procedures based on the Kozeny equation were developed for predicting pressure-volume-time relationships in constant pressure and constant rate filtration. In this paper, analytical equations corresponding to the graphical procedures are developed for constant rate filtration processes. (C.W.H.)

SYNTHESES

5303 UCRL-2971

California. Univ., Berkeley. Radiation Lab. STUDIES ON THE BIOSYNTHESIS OF C^{14} -LABELED SEDOHEPTULOSE IN SEDUM SPECTABILE L. A. Nordal, Andrew A. Benson, and M. Calvin. Apr. 22, 1955. 19p. Contract W-7405-eng-48.

The biosynthesis of sedoheptulose in the Sedum plant is studied to develop procedures for synthesizing C^{14} -labeled sedoheptulose in optimal yield. Preliminary investigations showed that very small amounts of C^{14} -labeled sedoheptulose were formed during the first 24 hours of photosynthesis in $C^{14}O_2$. The formation of C^{14} -labeled sedoheptulose as well as its relationship to the other C^{14} -labeled compounds, especially sucrose, glucose, and fructose, was studied. The rate of accumulation of free sedoheptulose in Sedum spectabile varied considerably with the age of the plants, the conditions under which the plants were kept before the experiments (atmospheric conditions, light and dark treatments), and the medium (water or nutrient solution) in which the plants were kept during the photosynthesis. Free sedoheptulose accumulates much more slowly than do sucrose, glucose and fructose, and, likewise, is only slowly depleted. Starved plants deprived of their reservoir of free hexoses still contained remarkable amounts of free sedoheptulose. In $C^{14}O_2$ they were always found to accumulate very little free radioactive sedoheptulose until the reservoirs of hexoses were restored. It is concluded that the unique sedoheptulose accumulation in Sedum is largely due to the relative inactivity of the required kinase. (auth)

TRACER APPLICATIONS

5304 UCRL-2849

California. Univ., Berkeley. Radiation Lab. EFFECT OF COENZYME A ON THE METABOLIC OXIDATION OF LABELED FATTY ACIDS: RATE STUDIES, INSTRUMENTATION, AND LIVER FRACTIONATION. B. M. Tolbert, Ann M. Hughes, Martha R. Kirk, and M. Calvin. Apr. 18, 1955. 30p. Contract W-7405-eng-48.

The effect of pantothenic acid deficiency on the rate of $C^{14}O_2$ excretion and on distribution of radioactivity in liver fractions has been studied in rats given sodium acetate- $2-C^{14}$ and sodium heptanoate- $7-C^{14}$. The rate of excretion of breath $C^{14}O_2$ has been measured by use of a method in which a sensitive ionization chamber and electrometer directly and continuously record C^{14} excretion. The labeled fatty acids are more rapidly metabolized to $C^{14}O_2$ in PAD rats than in normal rats. CoA depresses the $C^{14}O_2$ excretion in both normal and PAD rats in experiments with either labeled acid. There are differences in the oxidation of these two fatty acids, and the differences are consistent with postulated metabolic schemes. CoA increases radioactivity deposited in the fat of the liver, but does not appreciably change the radioactivity incorporated in the protein and nonsaponifiable lipid fractions. (auth)

5305 AEC-tr-2166

"THE CHEMISTRY OF ISOTOPES" BY A. I. BRODSKII (BRODSKIY). A book review by V. B. Ratinov. Translated from *Priroda*, No. 6, 121-3(1954). 4p.

TRANSURANIC ELEMENTS AND COMPOUNDS

5306

NEW ELEMENT MENDELEVIVM, ATOMIC NUMBER 101. A. Ghiorso, B. G. Harvey, G. R. Choppin, S. G. Thompson, and G. T. Seaborg (Univ. of California, Berkeley). *Phys. Rev.* 98, 1518-19(1955) June 1.

Very intense He ion bombardments of tiny targets of 99^{253} produced a few spontaneously fissionable atoms which elute in the *eka*-thulium position on a cation resin column. Production and identification procedures are discussed. (L.M.T.)

5307

NUCLEAR PROPERTIES OF 100^{256} . G. R. Choppin, B. G. Harvey, S. G. Thompson, and A. Ghiorso (Univ. of California, Berkeley). *Phys. Rev.* 98, 1519-20(1955) June 1.

The spontaneous fission half life was found to be approximately 3 to 4 hours. The predicted value of the α half life indicates that the α -to-spontaneous-fission ratio must be on the order of 0.04. (L.M.T.)

5308

SPONTANEOUS-FISSION NEUTRONS OF CALIFORNIUM-252 AND CURIVM-244. Donald A. Hicks, John Ise, Jr., and Robert V. Pyle (Univ. of California, Berkeley). *Phys. Rev.* 98, 1521-3(1955) June 1.

Further measurements of the multiplicities of prompt neutrons from the spontaneous fission of Cf^{252} and Cm^{244} have been made with improved apparatus. In a previous paper (*Phys. Rev.* 97, 564(1955)) the calculated multiplicity distribution is incorrect because of an error in the published value of ν (Cf^{252}). The corrected results are presented. (L.M.T.)

URANIUM AND URANIUM COMPOUNDS

5309

REACTION OF NITROGEN WITH URANIUM. M. W. Mallett

and A. F. Gerds (Battelle Memorial Inst., Columbus, Ohio). *J. Electrochem. Soc.* 102, 292-6(1955) June

Rates of reaction of nitrogen with uranium were determined by volumetric measurements in the temperature range 550 to 900°C at atmospheric pressure. The reactions were found to follow a parabolic rate law with some deviations initially and also after the period of parabolic reaction. Surface reaction products formed in the temperature range 550 to 750°C were identified by x-ray-diffraction studies to consist principally of UN_2 with slight evidence of U_2N_3 in some cases. Between 775 and 900°C the three nitrides UN , U_2N_3 , and UN_2 were found in the surface reaction product. The parabolic rate constant for the reaction between 550 and 750°C was found to be $k = 202 \exp(-25,500/RT)$ (ml/cm²)²/sec. The activation energy, 25,500 cal/mole, has a probable error of ± 1800 cal/mole. Between 775 and 900°C the parabolic rate constant is $k = 3.95 \exp(-15,100/RT)$ (ml/cm²)²/sec, where $15,100 \pm 2000$ cal/mole is the energy of activation. It has not been determined if the change in rate constant near the temperature of the beta to gamma transformation in uranium has any special significance. (auth)

ENGINEERING

5310 NP-5674

Standard Oil Co. of Indiana, Whiting.
DEVELOPMENT AND EVALUATION OF HIGH TEMPERATURE GREASES. QUARTERLY REPORT NO. 15 [FOR OCTOBER 10, 1954 TO JANUARY 10, 1955]. PARTS I AND II. Edward A. Swakon, Kemp R. Bunting, Morton Fainman, and Delmar D. Krebbiel. Jan. 1955. 27p. Contract AF33(038)-23687.

Monthly Report No. 44 is incorporated with this report and will not be submitted separately.

Work has been concerned with developing new thickening agents and with evaluating greases made with these materials in the best available fluids for high-temperature use. Some work was started toward the development of a suitable fluid. Heat stability and volatility of three of these fluids along with two new silicone fluids that were reported to have improved lubricity were determined. The criteria of grease evaluation were performance in the ABEC-NLGI Bearing Tester, Navy Gear-Wear Tester, linear screw-and-nut actuator, and low-temperature torque machine. (auth)

5311 WADC-TR-54-157

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.
SYNTHETIC LUBRICANTS FOR AIRCRAFT. Herbert Schwenker, John A. King, and James C. Mosteller. Nov. 1954. 61p.

Development of a -65° to 450°F grease for use in anti-friction bearings, electronic devices and other types of aircraft equipment is in progress. Emphasis is being placed on improving the wear characteristics of this grease and extending the low-temperature limits. In addition, research and development in greases is being devoted to improvement of grease availability and the investigation of oils and thickening agents. Synthetic lubricants for turbo-prop and turbojet applications have been formulated for use at temperature of -65° to greater than 400°F. High gear loadings encountered in some engine and accessory applications have required extensive research and development of suitable anti-wear additives. The presently available

hydraulic fluids offer a maximum usable temperature range of approximately 250°F. Speed and miniaturization of equipment, together with the necessity of operating hydraulic systems near heat producing bodies, has increased this temperature range to greater than 400°F. Experimental fluids of the diester and the organosilicon classes have been developed and are being evaluated. (auth)

HEAT TRANSFER AND FLUID FLOW

5312 AEC-tr-2175 (Rpt: UNCLASSIFIED)
INVESTIGATION OF THE EFFECT OF PRESSURE ON THE COEFFICIENT OF HEAT TRANSFER IN BOILER TUBES. F. F. Bogdanov. Translated by R. R. Kepple from *Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk*, No. 6, 137-44(1954). 7p.

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 9-1242.

5313 ATI-118811

A GENERALIZED INTEGRAL RELATION FOR THE THERMAL BOUNDARY LAYER AND ITS APPLICATION TO HEAT EXCHANGE COMPUTATIONS. (Obobshchennoye Integralnoye Sootnoshenie Dlia Teplovogo Pogranichnogo Sloya i Ego Primenenie k Raschetu Teploobmena). L. I. Kudriashev. Translated from *Doklady Akad. Nauk S.S.S.R.* 63, 23-6(1948). 6p. Available from Charles A. Meyer and Co., Inc., Nyack, N. Y. (F-TS-7471-RE)

The differential equations determining the velocity and temperature fields of a plane flow at high Reynolds' numbers are analyzed. (auth)

5314

TRANSIENT HEAT FLOW IN ORGANIC MATERIALS EXPOSED TO HIGH INTENSITY THERMAL RADIATION. Hoyt C. Hottel and Curtis C. Williams, III (Massachusetts Inst. of Tech, Cambridge). *Ind. Eng. Chem.* 47, 1136-43 (1955) June.

A mathematical analysis was made of the transient heat flow in wood and plastic samples which had been thermally irradiated at intensities up to 6 cal/cm²/sec for very short exposure times. (C.W.H.)

5315

CORRELATION OF TURBULENT VELOCITIES FOR TUBES AND PARALLEL PLATES. R. R. Rothfus and C. C. Monrad (Carnegie Inst. of Tech., Pittsburgh). *Ind. Eng. Chem.* 47, 1144-9(1955) June.

The main stream velocity distributions in fluids flowing in turbulent isothermal motion through smooth round tubes were correlated by means of modified parameters. These new parameters may also be applied to flow between parallel flat plates. (C.W.H.)

5316

EFFECT OF VIBRATION ON NATURAL CONVECTIVE HEAT TRANSFER. Robert Lemlich (Univ. of Cincinnati, Ohio). *Ind. Eng. Chem.* 47, 1175-80(1955) June.

Experiments indicate that vibration increases the coefficient of heat transfer in air. The vibrational variables may be correlated by a vibrational Reynolds number. The stretched film concept gave a fair explanation of vibration in air. Attempts were made to extend the correlations to other media. (C.W.H.)

5317

APPROXIMATE METHOD OF CALCULATING THE TURBULENT BOUNDARY LAYER IN THE PRESENCE OF

HEAT TRANSFER. M. B. Skopets. Zhur. Tekh. Fiz. **25**, 864-76(1955) May. (In Russian)

MATERIALS TESTING

5318 NP-5689

Mine Safety Appliances Co., Callery, Penna.

TEST OF A PISTON OPERATED VALVE FOR SODIUM SERVICE. R. A. Tidball and T. A. Ciarlariello. June 9, 1955. 28p. Contract NObs-65426, Technical Report No. 38.

An 8-in. piston operated split gate valve, fabricated by the Chapman Valve Mfg. Co. for water service, was re-modeled for sodium service and tested by exposure to 850°F sodium for 1152 hours during 4520 operating cycles. Seat leakages varied but were always below 0.4 cu ft/hr. Disassembly by the manufacturer showed no damage other than a blackening of the Malcolmized surfaces, but with no loss in hardness, and a slight deformation on the back of the gates. These tests showed that piston operated valves are suitable for sodium service. Changes are recommended to reduce the seat leakage and pumping power required for operation. (auth)

MINERALOGY, METALLURGY, AND CERAMICS

5319

RECENT INNOVATIONS IN THE CONTROL AND OPERATION OF ZIRCONIUM REDUCTION FURNACES. F. E. Block and A. D. Abraham (Bureau of Mines, Albany, Oreg.). J. Electrochem. Soc. **102**, 311-15(1955) June.

A general outline of the Kroll process for production of zirconium sponge is presented. Recent trends in automatic furnace control and instrumentation are reported. Modification of furnace operations to streamline production are discussed in terms of sponge quality. (auth)

CERAMICS AND REFRACTORIES

5320

INVESTIGATION OF THE RECIPROCAL DIFFUSION OF TITANIUM BORIDE AND NIOBIUM BORIDE. G. V. Samsonov and V. S. Neshpor (Moscow Inst. of Nonferrous Metals and Gold). Doklady Akad. Nauk S.S.S.R. **101**, 899-900(1955) Apr. 11. (In Russian)

CORROSION

5321

CORROSION. Mars G. Fontana. Ind. Eng. Chem. **47**, 91A-92A(1955) June.

Several procedures are outlined for stress-corrosion tests in metals. Types of corrosion specimens and methods of stressing the specimens are described. (C.W.H.)

5322

MATHEMATICAL STUDIES OF GALVANIC CORROSION. II. COPLANAR ELECTRODES WITH ONE ELECTRODE INFINITELY LARGE AND WITH EQUAL POLARIZATION PARAMETERS. James T. Waber and Marshall Rosenbluth (Los Alamos Scientific Lab., N. Mex.). J. Electrochem. Soc. **102**, 344-53(1955) June.

The expressions for the potential and current density distribution have been derived for the two mathematically

similar corrosion problems, (a) tiny anodes buried in infinite cathodes, and (b) tiny foreign cathodic inclusions in a metal. The implication of using equal polarization parameters has been discussed. When the critical dimension of the tiny electrode becomes smaller than the polarization parameter, corrosion attack and the interfacial potential become more uniform over the galvanic cell. Figures and perspective drawings made to scale are included to illustrate the effect of the polarization on the distribution of potential in the corroder and the diminishing variation of corrosion attack. (auth)

GEOLOGY AND MINERALOGY

5323 NP-5688

North Carolina. Dept. of Conservation and Development. **AN INTRODUCTION TO RADIOACTIVE MINERALS IN NORTH CAROLINA.** (INFORMATION CIRCULAR NO. 14). Richard J. Council. 1955. 22p.

The general physical and chemical properties, mode of occurrence, and general distribution of radioactive minerals, with particular emphasis on known occurrences in North Carolina are presented. It is an introduction to the field of radioactive materials, their detection, and occurrence in North Carolina. Other subjects, such as mineral rights and permits to prospect on private, state, and federal lands, are discussed briefly. Through the short discussions and summaries of these subjects, this report is designed to answer some of the questions arising in the minds of prospectors and potential prospectors for radioactive minerals in North Carolina. (auth)

5324 RME-2019

Division of Raw Materials. Salt Lake Exploration Branch, AEC.

GEOLOGY OF BLACK DYKE PROSPECT SIERRITA MOUNTAINS, PIMA COUNTY, ARIZONA. R. L. Wells and H. E. Puttuck. Sept. 1954. 12p.

The Black Dyke claims, are located in the Papago (Sierrita) mining district in the Sierrita Mountains of Pima County, Arizona. The uranium mineralization is exposed in an inclined shaft that extends to a depth of 150 ft vertically below the surface. The uranium mineralization occurs in pods, and is generally associated with pyrite and chalcopyrite, in zones of biotite granite which have been metamorphosed to a hornfels rock. The distribution of the uranium mineralization in small, scattered, irregular zones precludes the possibility of appreciable uranium production from the Black Dyke prospect. (auth)

5325 RME-2026

Division of Raw Materials. Salt Lake Exploration Branch, AEC.

MEMORANDUM REPORT ON THE URANIUM OCCURRENCE AT THE LULU BELLE CLAIMS, GILA COUNTY, ARIZONA. R. L. Wells. Jan. 1955. 13p.

Uranium-bearing vein material was discovered on the dump of an old shaft of the Lulu Belle Claims, and the workings were cleaned out in an effort to locate the source of the radioactive material. Some weak radioactivity was found associated with copper sulphides in a thin coating on the footwall plane of the main quartz vein. Assays from areas showing the strongest radioactivity were very low in uranium content. (auth)

5226 TEI-490

Geological Survey.

GEOLOGIC INVESTIGATIONS OF RADIOACTIVE DE-

POSITS. SEMI-ANNUAL PROGRESS REPORT, JUNE 1 TO NOVEMBER 30, 1954. Dec. 1954. 299p.

Investigations of radioactive materials in the United States and Alaska, and to a minor extent in foreign countries were undertaken. This report is a statement of progress during the six-months period from June 1 to November 30, 1954, and gives the principal information developed during that period. Many of the investigations discussed herein have advanced to the point where final reports are in preparation for future publication with the permission of the AEC. Other studies are still incomplete and the final reports cannot be expected for several years. The principal investigations by the USGS continued to be in the Colorado Plateau region of Colorado, Utah, Arizona, and New Mexico. The drilling program on the Plateau was continued, but no exploration was undertaken elsewhere during the period. (For preceding period see TEI-440.) (auth)

5327

STRATIGRAPHY OF THE MORRISON AND RELATED FORMATIONS, COLORADO PLATEAU REGION. A PRELIMINARY REPORT. Lawrence C. Craig. U. S. Geol. Survey Bull. 1009-E, 125-68(1955). \$0.20 (GPO).

Stratigraphic studies were made of the Glen Canyon Group, San Rafael Group, and the Morrison Formation in the Colorado Plateau region for the purpose of determining the paleogeography of the U-bearing formations of the Plateau. The sources of the ore minerals, their means and routes of transportation, and controlling factors for their localization in ore bodies were studied as an aid to guiding exploration for these deposits. A general summary of the results and interpretations warranted at this stage of the work are given. (auth)

5328

PRELIMINARY GEOLOGIC MAP OF THE SHIP ROCK AND HOGBACK QUADRANGLES, SAN JUAN COUNTY, NEW MEXICO. COAL INVESTIGATIONS MAP C-29. E. C. Beaumont. Washington, U. S. Geological Survey, 1955. \$0.50.

5329

PRELIMINARY GEOLOGIC MAP OF THE TOADELENA QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO. COAL INVESTIGATIONS MAP C-30. D. L. Ziegler. Washington, U. S. Geological Survey, 1955. \$0.50.

5330

PRELIMINARY GEOLOGIC MAP OF THE NASCHITTI QUADRANGLE, SAN JUAN AND MCKINLEY COUNTIES, NEW MEXICO. COAL INVESTIGATIONS MAP C-31. R. B. O'Sullivan. Washington, U. S. Geological Survey, 1955. \$0.50.

5331

PRELIMINARY GEOLOGIC MAP OF THE KIRTLAND QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO. COAL INVESTIGATIONS MAP C-32. E. C. Beaumont and R. B. O'Sullivan. Washington, U. S. Geological Survey, 1955. \$0.50.

5332

URANIFEROUS COAL BEDS IN PARTS OF NORTH DAKOTA, SOUTH DAKOTA, AND MONTANA. COAL INVESTIGATIONS MAP C-33. N. M. Denson, G. O. Bachman, H. D. Zeller, J. R. Gill, G. W. Moore, and R. E. Melin. Washington, U. S. Geological Survey, 1955. \$0.50.

5333

GEOLOGIC MAP OF CAVE HILLS AND TABLE MOUNTAIN

AREA, HARDING COUNTY, SOUTH DAKOTA. COAL INVESTIGATIONS MAP C-34. N. M. Denson, G. O. Bachman, and H. D. Zeller. Washington, U. S. Geological Survey, 1955. \$0.50.

5334

GEOLOGIC MAP OF THE SLIM BUTTES AREA, HARDING COUNTY, SOUTH DAKOTA. COAL INVESTIGATIONS MAP C-35. N. M. Denson, G. O. Bachman, and H. D. Zeller. Washington, U. S. Geological Survey, 1955. \$0.50.

5335

GEOLOGIC MAP OF THE SOUTHERN PART OF THE SLIM BUTTES AREA, HARDING COUNTY, SOUTH DAKOTA. COAL INVESTIGATIONS MAP C-36. George W. Moore and James R. Gill. Washington, U. S. Geological Survey, 1955. \$0.50.

5336

GEOLOGIC MAP OF THE BAR H AREA, SLIM BUTTES, HARDING COUNTY, SOUTH DAKOTA. COAL INVESTIGATIONS MAP C-37. H. D. Zeller. Washington, U. S. Geological Survey, 1955. \$0.50.

5337

MASS-SPECTROMETRIC METHOD FOR MEASURING THE AMOUNT OF RADIGENIC ARGON IN GEOLOGICAL FORMATIONS FOR DETERMINATION OF THEIR ABSOLUTE AGE. Kh. I. Amirkhanov, I. G. Gurvich, L. L. Shanin and S. S. Sardarov. Zhur. Tekh. Fiz. 25, 558-61(1955) (In Russian)

5338

MAKING URANIUM AT MONTICELLO. Richard L. Philippon (USAEC Grand Junction Operations Office, Colo.). Chem. Eng. Progr. 51, 261-5(1955) June.

The various procedures used at the Monticello (Utah) mill for the processing of ores containing U and V are discussed. (C.W.H.)

5339

THE LOCALIZATION OF BISMUTH IN ROCKS WITH NUCLEAR EMULSION PLATES. M. Debeauvais, F. G. Houtermans, E. Jäger, and W. Buser (Univ. of Bern, Switzerland). Tschermak's mineralog. u. petrog. Mitt. 5, No. 1-2, 129-36(1954). (In German)

METALS AND METALLURGY

5340 AD-26788

Battelle Memorial Inst., Columbus, Ohio.

SPOT-WELDED JOINTS IN TITANIUM ALLOYS AND THEIR BEHAVIOR IN FATIGUE. PROGRESS REPORT [FOR SEPTEMBER 10 TO NOVEMBER 10, 1953]. W. H. Kearns, W. S. Hyler, D. C. Martin, H. J. Grover, and C. B. Voldrich. Nov. 10, 1953. 18p. Contract AF33(616)-2005.

Commercially pure 0.045-in.-thick Ti sheet (RS-55) and Ti-7% Mn-alloy sheet (RS-120) were utilized for the spot-welding tests to observe the effect of weld time on the mechanical properties of the welds. The average tension-shear load of all tests was 1970 lb, and the average cross-tension load was 550 lb. The tension-to-shear ratio was 0.28. Spot-welding tests were made using a machine postheat cycle. The tension-shear strength was decreased as a result of increasing the 12-sec postheat current. Cross-tension strength was low in all tests. Tension-shear and cross-tension specimens were furnace heat treated to obtain data on ductile spot welds in the alloy sheet. The tension-to-shear ratio of the heat-treated specimens was 0.25. The tension-to-shear ratio of as-

welded specimens was 0.15. Radiographs were made of as-welded and machine heat-treated spot welds Mn-77, -78, -85, and -86, and no cracks or voids were noted. (ASTIA Abst.)

5341 AD-28580

Massachusetts Inst. of Tech., Cambridge.

RESEARCH ON CREEP STRUCTURE CHARACTERISTICS OF TITANIUM AND ITS ALLOYS. [QUARTERLY PROGRESS REPORT FOR THE PERIOD] NOVEMBER 1, 1953 TO FEBRUARY 1, 1954. John Lunsford, Lee Richardson, and Nicholas J. Grant. 6p. Contract DA-19-020-ORD-2787.

Two Ti alloys, one containing 5.9% Al and the other containing 0.34% O, were given creep-rupture tests in an He atmosphere. These specimens were observed to undergo cross-sectional changes. The test bar, originally of a round cross section, during testing first became rectangular in cross section, and then on approaching fracture assumed a 4-pointed star shape. These changes have thus far occurred as low as 1400°F and as high as 1800°F. (ASTIA abst.)

5342 AD-36827

Dow Chemical Co. Metallurgical Labs., Midland, Mich. PRINCIPLES OF THE EFFECT OF RARE EARTH ADDITIONS ON THE HIGH TEMPERATURE PROPERTIES OF MAGNESIUM. PHASE II. QUARTERLY REPORT NO. 8 FOR THE PERIOD JANUARY 1, 1954 TO MARCH 31, 1954. 28p. Contract AF33(038)-16655.

A quantitative analysis has been performed on several creep curves from magnesium-cerium alloys. Because of the negligible steady-state creep, it was possible to separate the strain into two components, transient and accelerating. The transient component shows a time dependence in agreement with that for electrolytic magnesium. The accelerating component, also definable as a power function of time, shows a consistency which supports the metallographic evidence that early tertiary creep under constant stress conditions is due to basic deformation mechanisms rather than to necking, cracking, or recrystallization. The apparent creep strain-induced shift of solubility equilibrium for a magnesium-6.2% aluminum alloy has been disproved by further results. (auth)

5343 AD-47926

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

TITANIUM ALLOYS FOR ELEVATED TEMPERATURE APPLICATION. QUARTERLY REPORT NO. 13 [FOR] JUNE 1, 1954 TO AUGUST 31, 1954. W. F. Carew, F. S. Crossley, and D. J. McPherson. Sept. 9, 1954. 36p. Contract AF33(038)-22806.

Research work of the previous year is reviewed and the work projected for the current contract period is outlined. All alloys for evaluation are in some stage of processing preparatory to testing except 6% Al-0.04% B, 6% Al-3% Mo-0.5% Be, and 5% Al-0.5% Be. Some testing on the last named alloys has begun. Preliminary data on the response of the 7% Al-3% Mo alloy to heat treatment are reported. Rolling data for an ingot of 7% Al-3% Mo alloy made with 140 BHN sponge are given. The alloy was rolled to 0.060 in. sheet at 1650°F. Creep-rupture, creep, and stability data are reported for a few alloys, testing of which began—but was not completed—in the preceding contract period. The results indicate the 3% Mo-0.5% Si alloy to be more creep

resistant at 300°C than 6% Al. However, this alloy suffers some loss of ductility upon exposure to creep conditions. (auth)

5344 AD-47976

Battelle Memorial Inst., Columbus, Ohio.

THE EFFECT OF GRAIN SIZE ON THE MECHANICAL PROPERTIES OF TITANIUM AND ITS ALLOYS. QUARTERLY PROGRESS REPORT NO. 6 [FOR JUNE 1, 1954 TO SEPTEMBER 1, 1954]. F. C. Holden, H. R. Ogden, and R. I. Jaffee. Sept. 15, 1954. 13p. Contract AF33'(616)-412.

A study of the effects of composition (including interstitial content) on the stability of titanium-base alpha-beta alloys shows that a Ti-5% Cr alloy is unstable after exposure for 200 hours at temperatures of 600 to 1000°F, and that the instability is increased by an addition of 0.1% oxygen. The Ti-Mo and Ti-2.5% Cr-2.5% Mo alloys are stable under the above conditions. A program is outlined for a study of the rolling temperature and heat-treatment variables on the stability of the ternary alpha-beta alloys. (G.L.S.)

5345 AD-48047

Michigan Univ., Ann Arbor. Engineering Research Inst. A SURVEY OF THE RELATIONS BETWEEN MICROSTRUCTURE AND ELEVATED-TEMPERATURE PROPERTIES OF FOUR LOW-ALLOYED STEELS AT 700° TO 1200°F. FINAL REPORT. A. I. Rush and J. W. Freeman. Mar. 31, 1954. 121p. Contract AF33(038)-13496.

The relationships between type of microstructure and properties at 700 to 1200°F were surveyed for four low-alloyed steels. The steels were SAE 4340, 1.25 Cr-Mo-Si-V ("17-22A" S), 3 Cr-Mo-W-V(H-40), and 13 Cr-Mo-W-V(C-422). Near pure structures were produced by isothermal transformation at a series of temperatures. Martensitic structures were produced by oil quenching. Normalized specimens were also included. Maximum Brinell hardness was kept at 280 to 320 by tempering the structures which had higher hardness as transformed. The results indicated that bainitic structures had maximum strength over the temperature range. Tempered martensite in general had intermediate to low strengths. Pearlites were relatively weak at low temperatures, but became similar to the bainites at the higher temperatures. These were considerable variation between high- and low-temperature bainite and between fine and coarse pearlite. Normalized materials apparently have generally high levels of strength because the usual structures developed are predominantly bainite. In most cases, rather wide variations in structure were possible with rather uniform properties. These were usually a predominantly strong and an abnormally weak structure within the generalizations. Alloy content controlled the level of strength for a given structure. Thus, while martensitic structures compared unfavorably to the bainites for SAE 4340 and "17-22A" S, the martensitic structure of the C-422 alloy was superior to the lower alloyed steels at the higher temperature and longer time periods. Reasonably good correlations were developed between the structures and properties of turbine wheels of the four alloys on the basis of the results of the survey. The general results from the survey appear to be useful for general guidance in heat treating alloys for high-temperature service. However, the survey is very limited and care should be used in extending the data until all the factors have been investigated. (auth)

5346 AD-49409

Frankford Arsenal. Pitman-Dunn Labs., Philadelphia. DETERMINATION OF HYDROGEN IN TITANIUM AND TITANIUM ALLOYS. M. Codell and G. Norwitz. Dec. 12, 1954. 16p. (S-4284)

The method generally being used for the determination of hydrogen in titanium and titanium alloys is the vacuum fusion method, which is costly and time consuming. An investigation was conducted to develop an inexpensive rapid method for this determination. An ignition method was developed in which the sample is burned in oxygen, the gases passed through copper oxide to ensure oxidation of the hydrogen to water, and the water collected in a weighed bulb containing Anhydron. A considerable problem in developing the method was to find means for preventing the large amount of heat generated by the reaction between titanium and oxygen from cracking the tube through which the oxygen passed. This was solved by placing the sample in a Vycor tube, 15 mm in diameter, and supporting this tube in the main reaction tube on clay supports. The method was applied to the determination of hydrogen over the range 0.005 to 1%. Commercial titanium and titanium alloys contain about 0.005 to 0.02% hydrogen. (auth)

5347 AECD-3660

Los Alamos Scientific Lab., N. Mex. SOME COMPOUNDS OF PLUTONIUM WITH METALLOID ELEMENTS (thesis). Alvin E. Gorum. 1955. Decl. June 21, 1955. 78p. Contract [W-7405-eng-36]. Submitted as thesis to Univ. of Arizona.

Experimental methods of the type employed for alloy preparation in metallurgical research have been used in attempts to prepare compounds of plutonium with four different metalloid elements: phosphorus, arsenic, selenium and tellurium. By means of their x-ray diffraction patterns the existences of six previously unknown compounds have been established, but the compositions and crystal structures of only three of the compounds have been determined. The three compounds completely identified are PuP, PuAs and PuTe, all face-centered cubic, NaCl type, with unit-cell dimensions of 5.664 ± 0.004 Å, 5.855 ± 0.004 Å, and 6.183 ± 0.004 Å, respectively. Powder-type diffraction patterns have been obtained for compounds of plutonium with arsenic, tellurium and selenium that have crystal structures more complex than NaCl type and that are not isostructural with any known arsenides, tellurides or selenides of either uranium or thorium. Of these compounds the two formed with arsenic and tellurium are believed to contain less plutonium than PuAs and PuTe. The compound formed with selenium may be PuSe, but it is believed to contain more selenium than this formula indicates. (auth)

5348 AECU-3038

Illinois. Univ., Urbana. [DIFFUSION IN PURE NOBLE METALS AND BINARY ALLOYS]. PROGRESS REPORT AND PUBLICATION LIST FOR AEC CONTRACT AT(11-1)-67, PROJECT NO. 3. F. Seitz and D. Lazarus. [1955]. 11p.

5349 BMI-1000

Battelle Memorial Inst., Columbus, Ohio. COMPILATION OF U.S. AND U.K. URANIUM AND THORIUM CONSTITUTIONAL DIAGRAMS. (FIRST EDITION). H. A. Saller and F. A. Rough. June 1, 1955. 141p. Contract W-7405-eng-92.

The two major sections in this compilation (uranium

alloy and thorium alloy constitutional diagrams are preceded by a discussion of the transformation and melting temperature of the base metal. This discussion is followed by the information for systems for which diagrams have been determined. After that, the information for systems which are less complete is given. The editorial position on referencing was to use "open-literature" references where they were available. In a limited number of cases, certain references not generally available represent the best background data, and they have been utilized. These are indicated as "unpublished information". (auth)

5350 BMI-1003

Battelle Memorial Inst., Columbus, Ohio. INITIAL INVESTIGATION OF NIOBIUM AND NIOBIUM-BASE ALLOYS. Henry A. Saller, John T. Stacy, and Stanley W. Porembka. May 23, 1955. 42p. Contract W-7405-eng-92.

Factors influencing the fabrication characteristics of arc-melted niobium and niobium-base alloys were studied. Shape and purity were found to determine workability. Small quantities of carbon, oxygen, and nitrogen were particularly deleterious to the formability of arc-melted niobium, while additions of titanium improved workability. Arc-melted niobium-base binary alloys containing chromium, molybdenum, tantalum, titanium, vanadium, and zirconium were investigated. Only arc-melted buttons of niobium-titanium alloys could be rolled directly even at temperatures as high as 2200°F. However, with proper precautions, alloys containing molybdenum, tantalum, titanium, vanadium, and zirconium could be cold forged. The high-temperature strength of niobium and niobium-titanium alloys was investigated. Additions of titanium improved the strength of arc-melted niobium at 2200°F, the optimum addition being 10 wt.%. The 100-hr rupture strengths at 1800°F of cold-rolled niobium, recrystallized niobium, and hot-rolled niobium-10 wt.% titanium alloy were estimated to be 16,500 psi, 14,500 psi, and 12,500 psi, respectively. (auth)

5351 BMI-1004

Battelle Memorial Inst., Columbus, Ohio. ELECTROPLATED METALS ON NIOBIUM. John G. Beach and C. L. Faust. May 24, 1955. 9p. Contract W-7405-eng-92.

Electroplated metal coatings on niobium are desired to aid subsequent cladding with wrought metals. Niobium was activated for adherent plating by electrolytic etching in a hydrofluoric acid solution. As-electroplated iron (0.5 mil) on niobium was difficult to pry off. Heat treatment for 1 hr at 1300°F after baking at 400°F resulted in excellent bonds that withstood severe deformation. Subsequent cladding of niobium should be promoted by the adherent iron layer. (auth)

5352 DP-107

Aeroprojects, Inc., West Chester, Penna. ULTRASONIC WELDING OF ALUMINUM. J. Byron Jones, Carmine F. DePrisco, and John G. Thomas. Feb. 1955. 48p. For Du Pont de Nemours (E. I.) and Co. Savannah River Lab. Contract AT(07-2)-1.

At various stages in the development of the ultrasonic welding process, test coupons of 2S aluminum were prepared to evaluate weld strength, the effect of thermal cycling up to 350°C, and corrosion resistance in an environment of 95°C aerated, distilled water. Substantial im-

provement in weld strength was obtained during the term of the program, and metallographic examination revealed good solid-phase bonding in isolated areas of the ultrasonically affected zone. Thermal cycling up to about 250°C had no effect on weld strength, although higher temperatures produced an adverse effect; improvement in thermal shock resistance may be possible. No effect of the corrosion environment was observed in five months of exposure. The significance of surface cleaning on weld quality was not clearly established. (auth)

5353 MRL-6

Watertown Arsenal. Materials Research Lab., Mass. HARDENABILITY OF TITANIUM ALLOYS CALCULATED FROM COMPOSITION: A PRELIMINARY EXAMINATION. Leonard D. Jaffe. Apr. 1955. 19p.

From data found in the literature, a method has been derived for calculating hardenability of titanium alloys from their composition. A single graph gives the contributions of each alloying element. These are simply added to a base hardenability for unalloyed titanium. Results are in satisfactory agreement with measured hardenabilities. Carbon and oxygen lower hardenability of titanium alloys; aluminum, vanadium, manganese, chromium, molybdenum, and iron raise it. (auth)

5354 MS-PR-54-46

Kaiser Aluminum and Chemical Corp., Spokane. INVESTIGATION OF THE FEASIBILITY OF DEVELOPING AND FABRICATING IMPROVED ALUMINUM ALLOYS THROUGH UTILIZATION OF POWDER METALLURGY TECHNIQUES. QUARTERLY REPORT NO. 3 [FOR] JUNE 1, 1954 THROUGH AUGUST 31, 1954. J. B. Hess. Sept. 13, 1954. 20p. Contract AF33(616)-2296. (AD-48176)

A metallographic study of the tensile fractures of the first lot of binary powder alloys containing selected refractory constituents in a matrix obtained from unalloyed aluminum powder showed that refractory particles coarser than approximately 40 μ frequently tended either to fracture internally or to pull free from the matrix during tensile testing. Such coarse particles accordingly introduce an inherent weakness into the microstructure of the alloys, in a manner analogous to coarse primary crystals in a conventional cast and wrought alloy. Extremely fine refractory particles apparently could not be sufficiently dispersed into the matrix by the powder blending and fabricating procedures used to avoid unbounded, friable clusters of the fine refractory particles which also constituted an inherent structural weakness. To avoid such extreme fines in subsequent alloy preparations, a small laboratory air classifier was constructed and used to eliminate fines smaller than approximately 10 μ in particle size from the various raw powders of refractory constituents. Successful leaching methods were developed to obtain small quantities of powders of the constituents CrAl₃ and Mg₂Si whose preparation had given some trouble in the earlier work. (auth)

5355 NACA-TN-3450

Lewis Flight Propulsion Lab., Cleveland. PRELIMINARY INVESTIGATION OF PROPERTIES OF HIGH-TEMPERATURE BRAZED JOINTS PROCESSED IN VACUUM OR IN MOLTEN SALT. C. A. Gyorgak and A. C. Francisco. May 1955. 29p.

An investigation was conducted to determine the effect of the variables temperature, time at temperature, and nickel addition to the braze alloy on the shear strength of

high-temperature-alloy brazed joints processed in vacuum or in molten salt. Both brazing methods produced shear strengths greater than those of joints processed in dry hydrogen. Vacuum brazing was superior to salt-bath brazing, average shear strengths being on the order of 63,000 and 48,000 psi, respectively. (auth)

5356 NBS-3273

National Bureau of Standards, Washington, D. C. CREEP AND CREEP-RUPTURE CHARACTERISTICS OF SOME RIVETED AND SPOT-WELDED LAP JOINTS OF AIRCRAFT MATERIALS. Leonard Mordfin. [Aug. 6, 1954]. 53p. (NACA-TN-3412)

Equipment, test techniques, and results are presented for an experimental investigation of the creep of lap joints. Riveted aluminum alloy joints fabricated from 75S-T6 and 24S-T3 sheet with 24S and 24S-T31 rivets were tested at 300, 400, and 500°F. Spot-welded joints of 1/4-hard, type 301 stainless steel were tested at 800°F. Each type of joint was also tested in tension at room temperature. (auth)

5357 NP-5677

Illinois Inst. of Tech., Chicago. CHEMICAL THERMODYNAMICS OF MATERIALS AT HIGH TEMPERATURES. TECHNICAL REPORT NO. 16. THE THERMODYNAMICS OF THE LIQUID SOLUTIONS IN THE TRIAD Cu-Ag-Au. I. THE Cu-Ag SYSTEM. Russell K. Edwards and James H. Downing. June 1955. 22p. Contract Nonr-1406. T. O. II.

The thermodynamics of the liquid Cu-Ag system have been investigated as part of a general study in the Cu-Ag-Au triad to consider the energetic relationships and chemical bonding among these elements. The study was conducted by the method of determination of the partial pressures over the liquid solutions as a function of composition and temperature. Partial pressures were measured by the molecular effusion technique and were related to the vapor pressures of the pure liquids similarly measured, and activities were calculated. The related thermodynamic properties for the mean temperature 1428°K. are reported, based on the temperature and composition dependencies of the activity data. The activities of both components demonstrate marked positive deviation from ideal solution behavior in the system, as might have been expected in view of the fact that a wide miscibility gap exists in the solid state for this system. Large positive values for partial and integral enthalpies of mixing were found. The partial and integral excess entropies of mixing are positive. (auth)

5358 NP-5678

California. Univ., Berkeley. Minerals Research Lab. CORRELATIONS OF HIGH TEMPERATURE CREEP DATA. Oleg D. Sherby and John E. Dorn. June 1, 1955. 37p. Contract N7-onr-295, T. O. II, Technical Report No. 41.

Fundamental experiments on aluminum and nickel reveal that creep at high temperatures is controlled by a single thermal activation process. This fact suggests the use of simple parameters to correlate creep strain, secondary creep, stress-rupture, and tensile data for metals at elevated temperatures. These methods are applied successfully to very high-temperature data for Pt, γ -Fe, Au, Cu, Mo, Be and Nb as well as to commercial steels, cast irons and complex high-temperature alloys. In addition, ceramic materials also appear to follow the same relations. The activation energies for creep of high-purity

metals are shown to equal the respective activation energies for self-diffusion. (auth)

5359 NP-5687

Massachusetts Inst. of Tech., Cambridge.

ISOTHERMAL SECTIONS IN THE SYSTEMS MOLYBDENUM-TUNGSTEN-CARBON AND MOLYBDENUM-TITANIUM-CARBON. TECHNICAL REPORT NO. 5.

Henry J. Albert. June 1955. 14p. Contract N5ori-07817.

In the molybdenum-carbon phase diagram, the existence of an MoC phase at high temperatures has been confirmed. This phase decomposes to Mo_2C and carbon on cooling. In the Mo-W-C isothermal section at 1710°C a single phase field was found to extend between Mo_2C and W_2C . No appreciable solubility of molybdenum in WC or tungsten in MoC was found. A small solubility of titanium in Mo_2C was found in the Mo-Ti-C isothermal section at 1710°C . To a much lesser extent titanium is soluble in MoC. Molybdenum is very soluble in TiC and at 50 at.% carbon almost all the titanium may be replaced by molybdenum. (auth)

5360 TID-3059

Technical Information Service, AEC.

WELDING AND BRAZING: A BIBLIOGRAPHY OF UNCLASSIFIED REPORT LITERATURE. Gifford A. Young, comp. Jan. 1955. 46p.

A selection of 226 unclassified reports held by the Technical Information Service as of October 1, 1954, and containing information on the welding and brazing of materials of interest to the AEC, such as Al, Be, Hf, Mo, Ta, Th, Ti, U, Zr, stainless steels, heat exchangers, and pressure vessels, has been annotated. Reports on corrosion and other properties of welded and brazed materials also have been abstracted. Author, subject, and report number indexes are included. (auth)

5361 WADC-TR-54-270(Pt.1)

Cornell Aeronautical Lab., Inc., Buffalo.

[SUBSTITUTES FOR CRITICAL AND STRATEGIC MATERIALS]. INVESTIGATION OF THE COMPRESSIVE, BEARING AND SMEAR CREEP-RUPTURE PROPERTIES OF AIRCRAFT STRUCTURAL METALS AND JOINTS AT ELEVATED TEMPERATURES. F. J. Vawter, G. J. Guarnieri, L. A. Terkovich, and G. Derrick. June 1954. 93p. Contract AF33(616)-190. (AD-47377)

An investigation was made to supplement conventional tensile creep data of several aircraft structural alloys with compression, bearing, and shear properties as well. While these data alone are of interest, a correlation is being attempted between tensile creep and compression, bearing, and shear creep properties so that the latter type of data may be predicted from tensile creep properties alone. Descriptions of equipment and fixtures for conducting tensile, compression, bearing, and shear creep tests are included. Tensile creep properties are reported at several test temperatures for the following alloys: 24S-T3 aluminum sheet, 0.064 and $\frac{3}{16}$ inch thick; type 321 stainless steel sheet; RC-130-A titanium sheet; Al7S-T4 aluminum rivet wire; Monel rivet wire; and type 301 stainless steel rivet wire. Bearing and shear creep characteristics are included for the 24S-T3 aluminum alloy. (auth)

5362 AEC-tr-2158

THE FORM OF PORES FORMED DURING THE INTERDIFFUSION OF METALS. Ya. E. Geguzin. Translated by Steven J. Rothman from Doklady Akad. Nauk S.S.S.R. **100**, 255-7(1955). 5p.

5363

METHODS OF BOND TESTING. W. J. McGonnagle, J. H. Monaweck, and W. G. Marburger (Argonne National Lab., Lemont, Ill.). Non-Destructive Testing **13**, No. 2, 17-22 (1955) Mar.-Apr.

A composite laminated type of metal construction used in a reactor necessitated fusion bonding of components for good heat transmission. A nondestructive test was needed which could differentiate between areas of intimate metal-to-metal contact with no bond and areas where the components were fused together. The thermographic, electrode potential, and ultrasonic transmission methods of testing were investigated. The experimental data show that the ultrasonic transmission method was the most sensitive, the electrode potential method moderately sensitive, and the thermographic method the least sensitive. (auth)

5364

THE EFFECT OF COBALT ON THE HIGH TEMPERATURE OXIDATION OF NICKEL. S. F. Frederick and I. Cornet (Univ. of California, Berkeley). J. Electrochem. Soc. **102**, 285-91(1955) June.

Nickel-cobalt alloys of high purity, in sheet form, were oxidized in air at temperatures ranging from 800 to 1400°C . The oxidation rate of high-purity carbonyl nickel was found to be lower than previously reported in the literature. The oxidation rate increased with increasing cobalt content, but the effect was small until over 11% cobalt had been added. The activation energy for oxidation decreased with increasing cobalt content from a value of 51 kcal/mole for pure nickel to about 28.8 kcal/mole for pure cobalt. (auth)

5365

PREPARATION OF TITANIUM BY FLUORIDE ELECTROLYSIS. M. A. Steinberg, S. S. Carlton, M. E. Sibert, and E. Wainer (Horizons Inc., Cleveland, Ohio). J. Electrochem. Soc. **102**, 332-40(1955) June.

Preparation of commercially pure titanium metal powder by electrolysis of K_2TiF_6 in molten NaCl is described. The process is carried out under an inert atmosphere in an all-graphite cell. Operating conditions of the electrolysis and their effect upon the metal so produced are discussed. Preparation of the K_2TiF_6 and the electrolytic procedure are completely described. The process is capable of producing metal of high purity which may be consolidated and fabricated by standard techniques as applied to metal powders. The metal is recovered by aqueous washing techniques. It may be prepared either as coarsely crystalline metal or as coarse thin metal flakes. (auth)

5366

DEFORMATION AND ANNEALING TEXTURES IN THORIUM. R. E. Smallman (Atomic Energy Research Establishment, Harwell, Berks, England). J. Inst. Metals **83**, 408-16(1955) May.

Pole figures of the sub-surface texture of thorium for various degrees of deformation have been determined, using both qualitative and quantitative methods. In the heavily rolled condition, the texture may be approximately described by four equivalent orientations near (123)[121]. On annealing, a re-orientation of about 40° rotation about a [111] axis takes place, resulting in a fairly well-developed cube texture (100)[001]. It is suggested that the deformation texture normally associated with face-centred cubic metals, viz. (110)[112], is really a transition texture developed from the true face-centred cubic texture of pure metals, viz. (123)[121], by the

introduction of solute atoms. This transition depends on the interaction energy of a solute atom and a dislocation in the parent lattice, and occurs only when this energy is sufficient to cause appreciable "atmosphere" locking. (auth)

5367

A PRELIMINARY NOTE ON THE CREEP PROPERTIES OF INTERNALLY OXIDIZED COPPER ALLOYS. J. W. Martin and G. C. Smith (Univ. of Cambridge, England). *J. Inst. Metals* **83**, 417-20 (1955) May.

Polycrystalline and single-crystal specimens of copper containing dispersed non-metallic phases were prepared by the technique of internal oxidation, and 100-hr constant-load creep tests were carried out at 200°C. A considerable improvement in creep-resistance under a stress of 3 tons/in.² was found on internally oxidizing a polycrystalline copper-0.05% aluminum alloy at 900 and 850°C. The creep-resistance of internally oxidized single crystals of a copper-0.3% silicon alloy was found to depend on the degree of dispersion of the oxide, the greater creep-resistance being shown by specimens containing the finer dispersion. (auth)

5368

THE SINTERING, FABRICATION, AND PROPERTIES OF THORIUM. M. D. Smith and R. W. K. Honeycombe (Univ. of Sheffield, England). *J. Inst. Metals* **83**, 421-6 (1955) May.

The powder metallurgy of thorium has been studied over a range of compacting pressures and sintering temperatures. The optimum conditions were obtained by pressing at 22.5 tons/in.², and then sintering in high vacuum for 2 hr at 1300°C. Metal of density approaching the theoretical was obtained by resintering after cold rolling to 50% reduction of thickness. Resintered metal, though having an average oxide content of 1.75 wt.%, was still very ductile. The influence of cold rolling on the mechanical properties of thorium has been determined, and the recovery and recrystallization of the cold-worked metal on subsequent annealing has been investigated for a range of deformations and temperatures. (auth)

5369

FUSION WELDING UNALLOYED TITANIUM SHEET WITHOUT FILLER ROD. Alan V. Levy and Robert Wickham. *Welding J. (N. Y.)* **34**, 413-19 (1955) May.

The great fluidity of titanium metal in the molten condition lends itself to fusion welding without the addition of filler metal. The resulting welds are flush with the base metal and have high ductility, comparable to the ductility of the base metal. The welded joints can be made by hand or automatic methods. A critical requirement of this type of weld is fitup of the parts to be joined. The backup and holddown fixtures also have a decided effect on the resulting weld. A sheared surface resulting in a no-gap joint is required for a satisfactory weld. Fused welds have been principally used, to date, for longitudinal tight butt joints in material up to 0.060 in. thick. Further testing and experience should extend the limits of application. (auth)

5370

THE STATIC AND FATIGUE BEHAVIOR OF SPOT-WELDED JOINTS IN TITANIUM. W. H. Kearns, W. S. Hyler, and D. C. Martin (Batelle Inst., Columbus, Ohio). *Welding J. (N. Y.)* **34**, 241s-50s (1955) May.

A study of the spot welding of titanium and titanium alloys was made to determine the behavior of six-spot weldments under fatigue loading and to compare the fatigue behavior of similar weldments in titanium, aluminum, and stainless steel. Commercially pure titanium sheet, commercial titanium-7% manganese alloy sheet, experimental unalloyed

titanium sheet, and Type 321 stainless steel sheet, all of 0.040-in. thickness, were used. Static tension-shear and cross-tension tests were made on single-spot welds in the materials and the tension-to-shear ratios were calculated. For equal gages and spot spacing, six-spot joints in the stainless steel sheet were slightly better in fatigue than similar joints in the titanium materials under similar loading conditions. The joints in the titanium materials were significantly better than similar joints in clad 24S-T and 75S-T aluminum alloys. Under static tension-shear loading, the joints in the titanium materials were stronger than similar joints in the stainless steel and the aluminum alloys. (auth)

5371

THE FLASH WELDING OF COMMERCIAL MOLYBDENUM. PART II. E. F. Nippes and W. H. Chang (Rensselaer Polytechnic Inst., Troy, N. Y.). *Welding J. (N. Y.)* **34**, 251s-64s (1955) May.

Welds of acceptable bend ductility have been produced in commercial molybdenum, both arc-cast and sintered, by flash welding in air. The ductility of these flash welds was impaired by entrapped oxides at the weld interface, the creation of a transverse fiber structure during upsetting, and carbide precipitation in the weld heat-affected zone. Increasing the upset distance to an optimum value assisted in eliminating entrapped oxides in both grades of molybdenum and reduced the severity of carbide precipitation in the arc-cast molybdenum. An increase in the amount of upset beyond the optimum value produced a transverse fiber structure in the weld zone causing severe reduction in bend ductility. Steep temperature gradients at the initiation of upset, produced by high rates of platen acceleration and short clamping distances, were found to localize the carbide precipitation and provide superior bend ductilities in the higher carbon arc-cast molybdenum. No improvement in bend-ductility was obtained with either arc-cast or sintered molybdenum when tank argon or tank hydrogen atmospheres were employed during welding. Flash welds made in arc-cast molybdenum showed the highest bend ductility when made in air, apparently a result of the decarburizing action of the oxygen. (auth)

5372

WELDING TYPE 347 STAINLESS STEEL FOR 1100°F TURBINE OPERATION. John M. Parks (Air Reduction Research Labs., Murray Hill, N. J.). *Welding J. (N. Y.)* **34**, 568-70 (1955) June.

Residual free ferrite in 18-8 stainless steel weld metal was used as a means of preventing hot cracking of weld deposits. If the weld metal composition is adjusted to produce 10% residual ferrite, complete ferritic envelopes about the austenitic grains may form; if the steel is heat treated or subjected to temperature service, this ferrite transforms to sigma phase and the resulting metal exhibits brittleness. By reducing the amount of free ferrite residual to approximately 2.5% by adjusting the electrode composition, the ferritic envelopes are less continuous and an improvement in impact strength and ductility is effected. The amount of residual ferrite required to prevent hot cracking is determined by the P and Si content in the molten weld metal and the maximum amount of ferrite that forms at the peritectic temperature. (auth)

5373

A MATHEMATICAL ANALYSIS OF THE TEMPERATURE DISTRIBUTION DURING FLASH WELDING. E. F. Nippes, W. F. Savage, H. Suzuki, and W. H. Chang (Rensselaer Poly-

technic Inst., Troy, N. Y.). Welding J. (N. Y.) **34**, 271s-85s (1955) June.

A mathematical analysis of the flashing operation as well as the nature of the stabilized temperature distribution established during flashing has led to the introduction of a new set of universal parameters with which the temperature distribution resulting from any given flashing pattern in a material may be correlated with a single, standard distribution form. The validity of such a distribution form for parabolic flashing has been satisfactorily verified by the experimental data obtained for aluminum alloys, steels and molybdenum. The effect of flashing variables, such as material constants, specimen size, rate of platen movement and initial clamping distance, on the stabilized temperature distribution has been discussed. Methods are proposed for choosing an adequate mean value of thermal diffusivity for a given material and for evaluating the amount of critical burn-off necessary to establish the stabilized temperature distribution. Examples are given for predicting temperature distributions and predetermining satisfactory flashing conditions. (auth)

5374

CONSIDERATIONS IN THE EVALUATION OF GRAPHITIZATION IN PIPING SYSTEMS. Helmut Thielsch, E. M. Phillips, and E. R. Jerome, Jr. (Grinnell Co., Inc., Providence, R. I.). Welding J. (N. Y.) **34**, 286s-94s (1955) June.

Laboratory investigations were reported of graphitized piping, sampling, bend and impact testing, and metallographic grading. Interpretation of test results, the number of specimens required, and the effects of heat treatments were presented. (auth)

5375

THE EFFECTS OF ALLOYING ELEMENTS ON WELDS IN TITANIUM. PART II. A STUDY OF COMMERCIALY IMPORTANT TITANIUM ALLOYING ELEMENTS TO DETERMINE HOW THEY AFFECT THE PROPERTIES OF WELDS IN TITANIUM. G. E. Faulkner (Battelle Memorial Inst., Columbus, Ohio). Welding J. (N. Y.) **34**, 295s-312s (1955) June.

Eighteen series of experimental titanium alloys, which contained additions of either aluminum or vanadium, or combined additions of two or more of most of the commercially important titanium alloying elements, were studied. The welding studies were conducted to determine the effects of alloying elements on the properties of welds in titanium alloys. Alloys which contained only the alpha-stabilizing element aluminum produced ductile welds with good notch toughness over the whole composition range studied. The ductility and notch toughness of welds in alloys which contained only the beta-stabilizing element vanadium generally became lower as the vanadium content increased and welds in some of the alloys were brittle. However, after heat treatment welds in all of the titanium-vanadium alloys were ductile. Alloys which contained combinations of beta-stabilizing elements and aluminum appeared promising for welding applications. Aluminum additions increased the strength of alpha-beta alloys but had little effect on the properties of welds in these alloys. However, no combination of beta-stabilizing elements was found to produce alloys with base-metal and weld-joint properties superior to those of alloys which contained other beta-stabilizing elements. (auth)

5376

EFFECTS OF HYDROGEN AT HIGH PRESSURES ON THE

MECHANICAL PROPERTIES OF METALS. I. APPARATUS, PROCEDURES, AND PRELIMINARY RESULTS. H. C. Van Ness and B. F. Dodge (Yale Univ., New Haven, Conn.). Chem. Eng. Progr. **51**, 266-71 (1955) June.

Hydrogen at pressures as low as 2000 atm can cause dangerous embrittlement of metals even at room temperature. At high temperatures also hydrogen can cause embrittlement, and in addition may attack steel chemically. Probably the most suitable material for use with high-pressure hydrogen is austenitic stainless steel. (auth)

5377

ON THE RELATION OF AGING AND RELAXATION COEFFICIENTS OF ALUMINUM TO THE RATE OF PLASTIC DEFORMATION. L. I. Vasil'ev. Zhur. Tekh. Fiz. **25**, 687-90 (1955) Apr. (In Russian)

5378

EFFECT OF ANNEALING TEMPERATURES AND DEGREE OF DEFORMATION ON PROPERTIES OF ALUMINUM. L. I. Vasil'ev and N. E. Pakhryaev. Zhur. Tekh. Fiz. **25**, 691-5 (1955) Apr. (In Russian)

5379

EFFECT OF ELECTROPOLISHING ON THE PHYSICAL CHEMICAL PROPERTIES OF THE SURFACE OF PURE ALUMINUM. P. V. Shchigolev (Inst. of Physical Chemistry, Moscow). Zhur. Fiz. Khim. **29**, 682-4 (1955) Apr. (In Russian)

PHYSICS

5380 NP-5675

Polaroid Corp., Cambridge, Mass.
SOME OPTICAL PROPERTIES OF TRANSPARENT SOLIDS. FINAL REPORT. Eugene S. Emerson. Apr. 27, 1955. 63p. Contract N7onr-39102.

The results of a number of studies of the optical properties of transparent solids, chiefly crystals of the isometric class are briefly summarized. Attention was mostly focused on the stress-optic (photoelastic) behavior of these isotropic solids. In the course of preparing single crystal blocks for observation, a method based on the use of epitaxis (oriented overgrowth) was evolved to ascertain the crystallographic directions in the ingots. The plasto-optic effects in single crystals resulting from mechanical deformation were also studied along with the, sometimes, concomitant enhancement of the photolytic susceptibility. These photochemical changes were manifested in the spectral absorption features of the solid. Synthetic lithium fluoride and other synthetic fluorides were subjected to spectrophotometric analysis and some explanations advanced as to the presence or absence of the characteristic absorption "notch" at 2.8 μ . A discussion of the relationship between the absolute space configuration and the electro-optic (also piezoelectric) effects in the cubic ZnS crystal is presented along with a discussion of the Pockels solid CuCl (or any solid of point group T_D) for use as an electro-optic light valve or shutter. The evergrowing number of crystalline materials successfully synthesized suggests their use for infrared optical elements such as polarizing prisms and birefringent phase shifters; these elements are discussed and illustrated. (auth)

5381 NP-5679

Stanford Research Inst., Calif.

DETERMINATION OF THE MECHANISM OF THE INCREASE OF VISCOSITY OF ORGANOSILICON COMPOUNDS AT HIGH TEMPERATURES. QUARTERLY PROGRESS REPORT [FOR] MARCH 15, 1955 TO JUNE 15, 1955. REPORT NO. 42. E. E. Ryskiewicz. June 15, 1955. 9p. Contract AF33(616)-168.

A 0.1% concentration of Ionol in tetra(2-pentoxy)silane protected the silane against hydrolysis for over 400 hours at 120°C. At 200°C this antioxidant was ineffective. A study was made of the hydrolysis of the tetraalkoxysilanes under heterogeneous conditions. Various products, representative of those which could be formed during oxidation, were shown to act as catalysts for the hydrolysis. There is an apparent correlation between water uptake during hydrolysis and the chemical structure of the isomers. (auth)

5382 ORNL-1852

Oak Ridge National Lab., Tenn.

SOLID STATE DIVISION SEMI-ANNUAL PROGRESS REPORT FOR PERIOD ENDING FEBRUARY 28, 1955. J. T. Howe, ed. June 10, 1955. 68p. Contract W-7405-eng-26.

Solid State Reactions. The behavior of p-type Ge bombarded with fast neutrons at room temperature gave excellent agreement with the energy level model of James and Lark-Horovitz at the beginning of the irradiation but diverged from the predicted behavior as bombardment proceeded. The data indicate that interstitials and vacancies have different annealing rates. The effect of radiation on hole mobility of p-type Ge is being studied. The variation of conductivity with temperature of n-type Ge after low-temperature irradiation has been investigated. During slow warmup the conductivity shows 2 decided peaks which are probably caused by the successive escape of trapped holes from 2 trapping levels of different energy. It was found that isothermal annealing of irradiated n-type Ge produced a decrease in conductivity at 0, 23.3, 80, and 100°C but an increase at 40 and 60°C. Nuclear doping is being investigated as an agent for determining the energy levels in Ge. Hall coefficient and resistivity of n- and p-type GaSb were measured before and after irradiation in a reactor, and results are reported. Magnetic susceptibility data on p-type InSb have been extended to 636°K, and data on n-type have been taken from 293 to 634°K. An apparatus has been built to permit magnetic susceptibility measurements to be made at temperatures down to 1°K. The effects of annealing on the conductivity of alkali halide crystals have been studied. Optical absorption curves were made on a sample of very pure silica after various amounts of fast neutron irradiation. No absorption bands occurred in the visible spectrum, and only one occurred in the ultraviolet. The effects of fast neutron irradiation of refractory single crystals such as zircon, beryl, chrysoberyl, and phenacite were studied, and results are reported. An extensive x-ray-diffraction investigation is being conducted in search of forbidden reflections in covalent single crystals such as diamond and Ge. Engineering Properties. The effects of radiation on the thermal conductivity of ceramics are being studied. X-ray-diffractometer patterns were obtained for a group of ceramics that had been exposed to 1×10^{20} and 2×10^{20} neutrons/cm². The patterns were compared with those of unirradiated samples, and results are tabulated. To correlate the radiation stability of plastics with Young's

modulus, a table of mechanical properties of commercial plastics has been prepared in which the plastics are grouped according to the values of their preirradiation Young's moduli. Crystal Physics. An in-pile cryostat is described which is designed to maintain the temperature of a sample below 20°K. Preirradiation measurements were made of the critical shear stress of α brass as a function of Zn concentration and temperature. Special Projects. Changes in neutron irradiated LiF single crystals determined by x-ray or density data were found to be equivalent when the elastic behavior of the crystal was considered. The effects of annealing were studied on the x-ray line broadening of neutron-irradiated LiF crystals. The increase in electrical resistivity of gold-cadmium alloys due to quenching is being studied. The effects of neutron irradiation on the precipitation hardening reaction in nickel-beryllium alloys and on resistivity changes in copper alloys are being investigated. X-ray-diffraction studies of irradiated polycrystalline Cu alloy samples indicate that the lattice parameters vary nearly linearly with atomic composition at low percentages of solute. An electronic apparatus has been designed and built to measure paramagnetic resonances, and results of measurements on irradiated piezo quartz are reported. (For preceding period see ORNL-1762.) (M.P.G.)

5383 UR-387

Rochester, N. Y. Univ. Atomic Energy Project.

A METHOD OF SHAPING THERMAL ENERGY PULSES FROM A CARBON ARC SOURCE. George Mixter, Jr. and Thomas P. Davis. May 2, 1955. 14p. Contract W-7401-eng-49.

A method is presented whereby the constant irradiance of a carbon arc source may be shaped to produce energy pulses of desired characteristics, without otherwise altering the optical or geometrical properties of the beam. This is accomplished by the interposition of a rotating slotted wheel, whose rate of rotation may be accurately controlled. The method in use has proven to be convenient and accurate. (auth)

5384 AEC-tr-2159

ON THE MECHANISM OF SELF-DIFFUSION IN LIQUIDS AND ITS SINGULARITY IN WATER. O. Ya. Samoilov (Samoylov). Translated by Steven J. Rothman from Doklady Akad. Nauk S.S.S.R. 101, 125-8(1955). 7p.

5385 AEC-tr-2167

X-RAY SPECTROGRAPHIC INVESTIGATION OF AGING METAL HYDROXIDES. R. Fricke and F. Wever. Translated by K. S. Bevis from Z. anorg. u. allgem. Chem. 136, 321-4(1924). 2p.

5386 NRL-Trans-484

THE INFLUENCE OF SURFACE ACTIVE SUBSTANCES ON THE OVERVOLTAGE OF HYDROGEN LIBERATION ON PLATINUM. (Vliyaniye Poverkhnostno-Aktivnykh Veshchestv Na Perenapryazhenie Vydeleniya Vodoroda Na Platine). V. L. Kheifets (Heifetz) and B. S. Krasikov. Translated by A. Pingell from Doklady Akad. Nauk S.S.S.R. 94, 101-4(1954). 7p.

An attempt was made to measure directly the adsorption ϕ_1 potentials for certain surface active substances and their comparison with variations of overvoltage in the presence of additions for the case of H discharges on smooth Pt. (auth)

5387

THE ISOTOPIC EFFECT OF THE ELECTROLYTIC DIF-

FUSION OF POTASSIUM ION IN MOLTEN POTASSIUM NITRATE. Arnold Lunden, Carl Reuterswärd, and Nils Sjöberg (Univ. of Uppsala, Sweden). Z. Naturforsch. **10a**, 279-81(1955) Apr. (In German)

In the electrolysis of molten KNO_3 , K^{39} is concentrated on the anode faster than K^{41} . The relative difference of the electrolytic diffusion velocity of these isotopes was determined to be 0.0018. The mass effect is $\mu = -0.036$. (tr-auth)

5388

MECHANISM OF MATERIAL TRANSPORT DURING SINTERING. Raymond F. Walker (National Bureau of Standards, Washington, D. C.). J. Am. Ceram. Soc. **38**, 187-97(1955) June.

Several mechanisms, such as volume or surface diffusion, viscous or plastic flow, and vapor transport, have been proposed in the literature to account for the transport of material during the sintering process. The manner in which such mechanisms can be responsible for experimental observations is reviewed, and attention is drawn to the limitations imposed by the present understanding of the principles involved. Examples are given of the theoretical models and mathematical expressions which have been derived for particular mechanisms and of attempts to apply these to empirical data. Suggestions for further investigations are given briefly. (auth)

5389

A METHOD OF CORRECTING THE BROADENING OF X-RAY LINE PROFILES. R. N. Bracewell (C.S.I.R.O., Sydney, Australia). Australian J. Phys. **8**, 61-7(1955) Mar.

A numerical method is presented which allows x-ray line profiles to be corrected for instrumental broadening. It provides an alternative to the use of Fourier analysis as described by Stokes. A special development of the method (as hitherto used) is necessary to permit its application to x-ray analysis where the $\text{K}\alpha$ doublet constitutes a complication. (auth)

5390

THERMAL STRESSES IN RECTANGULAR STRIPS. G. Horvay (Knolls Atomic Power Lab., Schenectady, N. Y.). Pages 313-22 of Proc. Second U. S. Natl. Congr. Appl. Mechanics, held at Univ. of Michigan June 14-18, 1954. New York, American Society of Mechanical Engineers.

Stresses and deformations ensuing from application of a step function temperature distribution to a rectangular strip are calculated by precise biharmonic eigenfunction expansions, by Fourier integrals, and by self-equilibrating function expansions. Superiority of the latter method, because of its great speed and yet adequate reliability, is clearly established. It is also shown that, contrary to expectation (whereby $\frac{1}{2} E \alpha T = \sigma_d$) the temperature step T is related to the design stress σ_d by $E \alpha T = 5/6 \sigma_d$. (auth)

ASTROPHYSICS

5391 UCRL-4503

California. Univ., Livermore. Radiation Lab.
ON THE MECHANISM OF GENERATION OF MAGNETO-HYDRODYNAMIC WHIRL RINGS IN THE INTERIOR OF THE SUN AND THEIR RELATION TO SUNSPOTS, FACULAE, PROMINENCES, AND FLARES. Winston H. Bostick. Mar. 29, 1955. 14p. Contract W-7405-eng-48.

A possible mechanism for the generation of magneto-hydrodynamic whirl rings near the center of the sun is

described. The organic relation of the reflection of these whirl rings at the surface of the sun to the cooling of sunspots, orientation, and polarity sequence of sunspots, prominences, flares, and faculae is delineated. (auth)

5392

ASSOCIATION OF A "UNIPOLAR" MAGNETIC REGION ON THE SUN WITH CHANGES OF PRIMARY COSMIC-RAY INTENSITY. J. A. Simpson (Inst. for Nuclear Studies, Chicago) and H. W. Babcock and H. D. Babcock (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). Phys. Rev. **98**, 1402-6(1955) June 1.

A new instrument for observing weak magnetic fields on the photosphere of the sun has recently revealed the presence of an unusual area on the solar surface which may be called a "unipolar" magnetic (UM) region because the field is of one sign and no magnetic flux has been found returning to the sun. A region of this type was observed at central solar meridian on seven consecutive solar rotations in 1953. In the present paper it is shown that there is a striking association of this UM region with (1) times of maximum primary cosmic ray intensity as measured by neutron detectors and an ionization chamber, and with (2) the recurring geomagnetic storms—the geomagnetic disturbances being most pronounced ~3 to 4 days after both the central meridian passage of the UM region and the time of maximum cosmic-ray intensity. (auth)

COSMIC RADIATION

5393

MEASUREMENT OF MASSES BY MOMENTUM AND IONIZATION AND MOMENTUM SPECTRA OF VARIOUS PARTICLES IN COSMIC RADIATION AT SEA LEVEL. V. A. Lyubimov, G. P. Eliseev, and V. K. Kosmachevskii. Doklady Akad. Nauk S.S.S.R. **102**, 57-60(1955) May 1. (In Russian).

Data on electrons, mesons, protons, and particles with masses of about 100 m_e are tabulated and graphed. (G.Y.)

5394

SPECTRA OF π MESONS AT SEA LEVEL UNDER LEAD FILTERS OF VARIOUS THICKNESSES. V. A. Lyubimov, G. P. Eliseev, and V. K. Kosmachevskii. Doklady Akad. Nauk S.S.S.R. **102**, 249-51(1955) May 11. (In Russian)

5395

OBSERVATIONS ON THE PENETRATING COMPONENT OF EXTENSIVE AIR SHOWERS. V. C. Officer and P. J. Eccles (Univ. of Melbourne, Australia). Australian J. Phys. **8**, 136-47(1955) Mar.

The variation in the composition of the penetrating component of extensive air showers at sea-level has been investigated as a function of shower density. The proportion of N particles in the penetrating component was observed to decrease as the shower density decreased. It is suggested that this behavior is due to the filtering action of the atmosphere on the more absorbable particles in the nuclear cascade which has passed maximum development. The zenith angle distribution of the penetrating μ mesons in air showers has been found to be the form $\cos^8 \theta$ which is consistent with that expected for shower axes, and gives no evidence for the broader distribution reported at mountain altitudes. An anomalous deficiency of penetrating μ mesons with zenith angles less than 5° has been found in air showers of median density 10 m^{-2} . (auth)

5396

STUDIES ON THE THEORY OF CASCADES. II L. Yanosli (Central Physics Research Inst., Budapest). Zhur. Eksptl'. i Teoret. Fiz. 26, 518-36(1954) May (In Russian; cf. NSA 9-1919)

5397

VARIATIONS IN INTENSITY OF COSMIC RAYS AND THE ROLE OF METEOROLOGICAL FACTORS. L. I. Dorman, A. I. Kuz'min, G. V. Tuanutova, E. L. Feinberg, and Yu. G. Shafer. Zhur. Eksptl'. i Teoret. Fiz. 26, 537-44(1954) May. (In Russian)

ELECTRICAL DISCHARGE

5398 OSR-TN-55-165

Syracuse Univ., N. Y. Inst. of Industrial Research and Harvard Univ., Cambridge, Mass.

A MODEL FOR COLLISION PROCESSES IN GASES. II. SMALL AMPLITUDE OSCILLATIONS OF CHARGED TWO COMPONENT SYSTEMS. E. P. Gross and M. Krook. June 1955. 39p. Contract AF18(600)-1124.

The general features of the small amplitude oscillations of a two-component ionized gas are discussed; the effects of the random thermal motions of ions and electrons are described by distribution functions. When collisions are neglected there are two types of waves for a given wavelength. One is a high-frequency electron plasma oscillation, slightly modified by ionic motions. The other is the Tonks-Langmuir positive-ion oscillation which is shown to be undamped when the electron temperature is considerably greater than the ion temperature. The effects of collisions are treated by a kinetic model which satisfies the conservation laws and provides for energy and momentum exchange between components. The low-pressure waves are damped with increasing collision frequency and decreasing electron temperature. The validity of transport treatments is investigated. At high density and high frequency one finds the correct sound wave for a mixture of gases. Study of the frequency as a series of inverse powers of the collision frequency shows that the first power term yields absorption independent of the electric charge. Higher powers give contributions to the absorption and dispersion which depend on electrical polarization as well as on diffusion, viscosity, and heat conductivity. The behavior at low frequency and high pressure depends on the electric charge more directly. (auth)

5399 NRL-Trans-398

REMARKS ON THE KINETICS OF MAGNETIZATION OF A CLASSICAL ELECTRON GAS. (Zamechaniya k Kinetike Namagnichevaniya Klassicheskogo Elektronnogo Gaza). I. Z. Fisher. Translated by A. Pingell from Zhur. Eksptl'. i Teoret. Fiz. 19, 937-9(1949). 6p.

The functions of distribution and the magnetic moment of the classical electron gas in a variable magnetic field are calculated. (auth)

ELECTRONS

5400

METHOD FOR SOLVING A WIDE CLASS OF ELECTROSTATIC AND MAGNETIC FIELDS FOR WHICH DERIVATIONS OF THE FUNDAMENTAL EQUATION OF ELECTRON OPTICS ARE EXPRESSED IN KNOWN FUNCTIONS. B. E. Bonshtedt. Zhur. Tekh. Fiz. 25, 541-3(1955) Mar. (In Russian)

5401

INVESTIGATION OF THE ELECTRON-OPTICAL PROPERTIES OF A STRAIGHT MAGNETIC SLIT. S. N. Baranovskii, D. L. Kaminskii, and V. M. Kel'man. Zhur. Tekh. Fiz. 25, 610-24(1955) Apr. (In Russian)

5402

INVESTIGATION OF FOCUSING PROPERTIES OF MAGNETIC CYLINDRICAL LENSES AND SYSTEMS COMPOSED OF SUCH LENSES. S. R. Yavor. Zhur. Tekh. Fiz. 25, 779-90(1955) May. (In Russian)

5403

ON THE CALCULATION OF A MAGNETIC FIELD FOCUSING AN ELECTRON BEAM OF GIVEN TYPE. I. I. Tsukkerman. Zhur. Tekh. Fiz. 25, 853-60(1955) May. (In Russian)

GASES

5404 AECU-3034

RAND Corp., Santa Monica, Calif.

STARK FIELDS FROM IONS IN A PLASMA. A. A. Broyles. Mar. 28, 1955. 22p. For Los Alamos Scientific Lab. [Contract W-7405-eng-36], Subcontract SC-9. (P-663 (RAND))

A method is described here for determining the probability of obtaining a given electric field on an ion in a plasma. This quantity is essential for computing the broadening of spectral lines from neighboring ions and therefore for their contribution to the opacity. The Pines-Bohm method of separation into long- and short-range coulomb interactions has been employed. It is argued that the formulas give the line width for iron at one kilovolt and normal density to $\pm 3\%$. (auth)

5405 AEC-tr-2174

EMISSION OF ULTRAVIOLET RADIATION IN GASEOUS MIXTURES EXPOSED TO THE ACTION OF ALPHA PARTICLES. Solange Lormeau-Loustau. Translated by K. S. Bevis from Compt. rend. 240, 768-70(1955). 2p.

An abstract of this paper appears in Nuclear Science Abstracts as NSA 9-3241.

INSTRUMENTS

5406 ISC-598

Ames Lab., Ames, Iowa.

A VOLTAGE CALIBRATION SYSTEM FOR ACCURATE PULSE-HEIGHT MEASUREMENT. W. A. Rhinehart and D. J. Zaffarano. Apr. 14, 1955. 15p. Contract W-7405-eng-82.

A system is described for accurately measuring the amplitudes of voltage pulses. The system is particularly suited for obtaining calibration and linearity data on amplifiers, pulse-height analyzers, pulse attenuators, and other pulse equipment commonly found in the field of nuclear research. An accuracy of 0.3% is maintained for unknown voltage pulses of 0.1-v to 200-v magnitude and of either positive or negative polarity. A visual comparison method is used which enables any given point of a voltage waveform to be measured. (auth)

5407 UCRL-2989

California. Univ., Berkeley. Radiation Lab.

THE USE OF INDIUM IN HIGH-VACUUM EQUIPMENT. F. L. Reynolds. May 23, 1955. 4p. Contract W-7405-eng-48.

Indium gaskets and valves have been developed for use in high-vacuum systems. These instrument parts do not require organic material as a vacuum seal. (C.W.H.)

5408

A STABILIZED CURRENT SUPPLY FOR A MASS SPECTROMETER, SURFACE IONIZATION, SOURCE. K. L. Aitken, Aitken, F. Hart, and P. Reynolds (Atomic Energy Research Establishment, Harwell, Berks, England). J. Sci. Instr. **32**, 190-1(1955) May.

A current stabilizer has been designed for the filament of a mass spectrometer ion source, and a circuit diagram is presented. Current stability of $\pm 0.02\%$ has been obtained for periods of the order of $\frac{1}{2}$ hour using an unstabilized voltage supply. At the maximum current of 4.8 amp, the circuit is capable of supplying an output voltage of up to 2 v. (M.P.G.)

5409

A SIMPLE METAL-TO-METAL VACUUM VALVE. G. W. Green (Atomic Energy Research Establishment, Harwell, Berks, England). J. Sci. Instr. **32**, 192(1955) May.

A vacuum valve is described which is simple and cheap to make, is robust and reliable, and has a high pumping speed. The end of one of the connecting tubes is used as a seal so that, when the valve is closed, its vacuum tightness on one side does not depend on O-ring glands or soldered joints. Testing of several valves at a differential pressure of 4 atm. revealed no leaks. (M.P.G.)

5410

TWIN KNUDSEN EFFUSION APPARATUS FOR SMALL SAMPLES OF RADIOACTIVE MATERIALS. Stephen C. Carniglia and B. B. Cunningham (Univ. of California, Berkeley). Rev. Sci. Instr. **26**, 485-8(1955) May.

A twin Knudsen apparatus for the measurement of vapor pressures is described. The apparatus has been employed in the temperature range 1140 to 1412°K, using approximately one mg samples of PuF_3 , AmF_3 and Am metal. Radiometric assay of condensed effusates yielded vapor pressure data in the range $\sim 5 \times 10^{-7}$ mm to $\sim 2 \times 10^{-3}$ mm that were internally consistent within a mean deviation of $\pm 5\%$. The apparatus is particularly suitable for the determination of small differences in vapor pressure of similar substances. (auth)

5411

NUCLEAR PLATE COATING DEVICE FOR AUDIO-RADIOGRAPHY. Leon C. Edwards (Massachusetts General Hospital, Boston). Rev. Sci. Instr. **26**, 515-16 (1955) May.

A device is described which coats nuclear plates with an exceedingly thin emulsion film. The instrument consists of a stationary platform, a retractable coating arm and clamp to hold a beveled glass coater, and a traveling slide carrier. The device has been used for the preparation of nuclear track plates on glass and Lucite, and for coating emulsion over previously mounted histological sections. (M.P.G.)

5412

NEW POLAROGRAPHIC ELECTRODE EMPLOYING CONTROLLED STIRRING. Paul Arthur, Joseph C. Komyathy, Roy F. Maness, and Herman W. Vaughan (Oklahoma Agricultural and Mechanical Coll., Stillwater). Anal. Chem. **27**, 895-8(1955) June.

An apparatus is described in which the solution surrounding a stationary electrode of small diameter is stirred by means of a revolving tube, the lower end of which surrounds the electrode. With a wax-coated, mercury-filled electrode

tube, excellent polarograms can be made. The curves are reproducible, smooth, and easily measurable. Large diffusion currents and very small residual currents are characteristic. With the proper techniques the curve obtained can be used to determine n values. Half-wave potentials for cathodic reactions are usually somewhat more negative than those obtained with the dropping mercury electrode, the magnitude of this variation (0.00 to 0.075 volt) depending upon the ion studied and, in some cases, its concentration. For those ions studied, the diffusion currents varied linearly with concentration. (auth)

5413

A DESIGN METHOD FOR DIRECT-COUPLED FLIP-FLOPS. W. Renwick and M. Phister (Univ. Mathematical Lab., Cambridge, England). Electronic Eng. **27**, 246-50(1955) June.

A method is developed for designing a flip-flop which will be stable with a given tolerance on resistors, voltage supplies, and tube characteristics, which is a requirement for a flip-flop for use in a high-speed digital computer. It is shown that when the supply voltages are not fixed by other considerations, the principal time constant of the circuit can be minimized by properly choosing the supply voltages. The method is applicable to all direct-coupled switching circuits. (auth)

ISOTOPES

5414

VACUUM WAVE-LENGTH MEASUREMENTS IN THE ULTRA-VIOLET SPECTRUM OF ISOTOPE NEON-20. J. Blackie and T. A. Littlefield (King's Coll., Newcastle upon Tyne, England). Proc. Roy. Soc. (London) **A229**, 468-72(1955) May 24.

The vacuum wave-lengths of 21 lines in the spectrum of Ne^{20} have been measured in the region 3376 to 3756 Å using a reflecting echelon interferometer. Since the standard error is rather less than $\pm 0.0001\text{Å}$ and this is supported by an examination of inter-level differences, the wave-lengths have been expressed to eight significant figures. (auth)

ISOTOPE SEPARATION

5415

ULTRASONIC UNMIXING OF ISOTOPIC SOLUTIONS. S. G. Bankoff and R. N. Lyon (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem. **47**, 1183(1955) June.

It is shown by means of thermodynamic relationships that negligible steady-state separation can be expected from passing ultrasonic radiation through gaseous mixtures of isotopic constituents. (C.W.H.)

MASS SPECTROGRAPHY

5416

PERFORMANCE OF THE NONMAGNETIC RADIO-FREQUENCY MASS SPECTROMETER TUBE. T. C. Wherry and F. W. Karasek (Phillips Petroleum Co., Bartlesville, Okla.). J. Appl. Phys. **26**, 682-5(1955) June.

The nonmagnetic radio-frequency principle of mass selection appears attractive because it promises to result in a mass spectrometer of simple construction and rugged nature. Accurate evaluation of the use of this principle is difficult because of the lack of published performance data. In an effort to obtain performance data a 5-stage Bennett-type tube with stage separation of 5-9-4-7 cycles has been constructed and operational variables studied theoretically and

experimentally. The experimental results are encouraging. They indicate the tube is capable of sufficient stability, resolving power, and sensitivity to be used for many analytical and research problems. Electronic circuits required to achieve a reasonable stability are relatively simple. (auth)

5417

ON "SPLIT" PEAKS IN THE MASS SPECTRUM OF HYDROGEN. N. N. Tunitskil, R. M. Smirnova, and M. V. Tikhomirov (Karpov Physico-Chemical Research Inst., Moscow).

Doklady Akad. Nauk S.S.S.R. 101, 1083-4 (1955) Apr. (In Russian)

Dissociation of molecular H_2^+ and D_2^+ beams is discussed. (G.Y.)

MATHEMATICS

5418 AD-48049

Illinois. Univ., Urbana. Statistical Research Lab.

TWO-SAMPLE PROCEDURES IN SIMULTANEOUS ESTIMATION. W. C. Healy, Jr. Nov. 8, 1954. 40p.

Contract DA-11-022-ORD-881.

Two-sample procedures of the type originated by Stein are developed for a number of problems in simultaneous estimation. The results include the construction of simultaneous confidence intervals of prescribed lengths and confidence coefficient $1-\beta$ for all normalized linear functions of means, all differences between means, and the means of k independent normal populations with common unknown variance. Simultaneous confidence intervals of length l and confidence coefficient known to be not less than $1-\beta$ are constructed for all normalized linear functions of the means of a general multivariate normal population. The single sample analogues of these problems have been discussed by Tukey, Scheffe, and Bose and Roy. Also a confidence region having prescribed diameter (or volume) and confidence coefficient $1-\beta$ is constructed for the mean vector in the general multivariate normal case. The procedures depend only on known and tabulated distributions. Illustrative applications from the analysis of variance are discussed. (auth)

5419 BNL-321

Brookhaven National Lab., Upton, N. Y.

BIBLIOGRAPHY ON MACHINE COMPUTATION, 1945-1954. Marjorie Comstock, comp. May 1955. 38p.

5420 IDO-14340

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

OPERATIONS EVALUATION AS APPLIED TO MEASUREMENT CONTROL PROGRAMS IN PLANT-SCALE RECOVERY OF SPENT REACTOR FUELS AT THE IDAHO CHEMICAL PROCESSING PLANT. Frank P. Vance and Fred H. Tingey. June 3, 1955. 28p. Contract AT(10-1)-285.

Multi-variate regression analysis of process data has produced empirical relationships and the basis for construction of control charts which serve as independent checks on certain measurements, and provide a mode of process surveillance, both for the need of measurement re-run, and for the appearance of trouble in the process. Thus, realistic measurement uncertainties have been put into effect throughout the plant, utilizing data collected from regular process samples. This has enabled definition of conditions for dissolver charging under explicit requirements imposed by the danger of nuclear criticality. By this

means, dissolver charges have been maximized, resulting in a significant elevation of dissolution rate. Statistical analysis of data from the non-destructive assay of MTR fuel elements is described. A routine technique for these measurements was thus evolved which when coupled with sequential inspection limits, provided a basis for acceptance of the elements, and produced data for reactor and accountability purposes. The optimization of measurement control effort with precision as described in this study warranted close scrutiny because of the value of the material. The same principle will apply equally, whether the material being handled is uranium, butadiene, or polio vaccine. (auth)

5421 AEC-tr-2172

DETERMINING A DIFFERENTIAL EQUATION ACCORDING TO ITS SPECTRAL FUNCTION. I. M. Gel'fand and B. M. Levitan. Translated from *Izvest. Akad. Nauk S.S.S.R. Ser. Mat.* 15, 309-60 (1951). 74p.

The paper describes methods of reduction of a second order differential equation according to its spectral function $\rho(\lambda)$. This problem is reduced to a certain linear integral equation. It is also ascertained what monotonic functions $\rho(\lambda)$ can serve as spectral functions of a differential equation of the second order. (auth)

MEASURING INSTRUMENTS AND TECHNIQUES

5422 IDO-16110(1st Rev.)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

MEASUREMENT OF TIME JITTER IN BF_3 PROPORTIONAL COUNTERS. O. D. Simpson and R. G. Fluharty. Apr. 25, 1955. 19p. Contract AT(10-1)-205.

Time jitter or the variations in time delay after a neutron is absorbed until the α particle pulse is recorded has been measured for some commercial BF_3 counters. The gamma rays from the 470-kev level in Li^7 were detected by means of a NaI scintillation counter and were used to trigger an oscilloscope trace. By measuring the time distribution of the α particle pulses, the time jitter could be determined. A counter of 2 in. diameter, 40 cm Hg pressure of BF_3 , and with a 0.002 in. center wire showed variations of 3 μ sec (the time between 50% of the maximum probability values). A counter of 1 in. diameter, 65 cm Hg pressure of BF_3 , and a 0.006 in. center wire showed variations of 0.5 μ sec. Factors involved in BF_3 counting characteristics are discussed with emphasis upon fast neutron chopper detectors. (auth)

5423 IDO-16120(1st Rev.)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

A PRELIMINARY REPORT ON THE MTR CRYSTAL SPECTROMETER. J. E. Evans. Apr. 25, 1955. 15p. Contract AT(10-1)-205.

A neutron crystal spectrometer has been placed in operation at the MTR. It is equipped for remote manual and automatic operation. Using the 240 planes of a $\frac{3}{16}$ " slab of natural NaCl in transmission, counting rates of 500,000 cpm at 0.07 ev; 12,000 cpm at 1 ev; and 3,000 cpm at 10 ev have been obtained. At these counting rates, special attention must be given to the conditions under which the BF_3 counters are operated. In calibration runs, the total cross sections of In, Ta, and Ti have been measured from 0.05 ev to 100 ev. (auth)

5424 IDO-16149(1st Rev.)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

THE QUANTITATIVE TECHNIQUES OF SCINTILLATION SPECTROMETRY AS APPLIED TO THE CALIBRATION OF STANDARD SOURCES. R. L. Heath and F. Schroeder. Apr. 25, 1955. 16p. Contract AT(10-1)-205.

A brief discussion is presented of the determination of absolute gamma emission rates for monoenergetic gamma emitters using a single-channel scintillation spectrometer. Examples are given for Cr^{51} , Cs^{137} , Nb^{95} , and Zn^{65} . Sources of error are discussed and steps being taken to improve the accuracy of the method are described. (auth)

5425 IER-30

Naval Radiological Defense Lab., San Francisco.

EVALUATION AND MODIFICATION OF RAYCHRONIX E-1 FAST NEUTRON DOSIMETER. George A. Work and John S. Denham. Sept. 30, 1954. 26p.

The Raychronix E-1 Fast Neutron Dosimeter is widely used for monitoring neutron fluxes, in military as well as civilian installations. Four E-1 dosimeters belonging to the USS NAUTILUS were forwarded to USNRDL for modifications suggested on the basis of operator complaints. Circuit re-design at the laboratory has resulted in a substantial improvement of the zero drift and sensitivity drift characteristics of the instruments. Circuit operation was modified so that the charge on the integrating capacitor may be stored while the instrument is re-zeroed, allowing for the more accurate measurement of extremely low neutron fluxes. Without total redesign of the detector assembly, it was not possible to satisfy the objections as to prolonged response time or insensitivity in low neutron fluxes. The neutron energy response of the instrument was determined at the energies of radium-beryllium and polonium-beryllium neutron sources. Response was also determined to neutrons of approximately 100 kev and 200 kev energies, using the NRDL Van de Graaff accelerator. The effects of gamma ray intensity and discriminator settings as they relate to the neutron response are shown graphically. (auth)

5426 NEVIS-10

Columbia Univ., Iryington-on-Hudson, N. Y. Nevis Cyclotron Labs.

LIQUID PROPANE BUBBLE CHAMBER. J. Leitner, N. Samios, M. Schwartz, and J. Steinberger. May 1955. 10p. Sponsored by ONR and AEC under Contract N6-ori-110, Task No. 1. (CU-84-55-ONR-110-1-Phys.)

A glass and metal liquid propane bubble chamber is described. A piston type expansion mechanism permits fast recompression and consequently, large duty cycles. Dark field illumination provides good contrast and uniformity at large stereo angles. The use of plates within the sensitive volume is discussed. (auth)

5427 WAL-401/207

Watertown Arsenal Lab., Mass.

THE CALIBRATION OF A POLONIUM-BERYLLIUM NEUTRON SOURCE. Alfred J. Moses and John J. O'Connor. Aug. 20, 1954. 23p.

Activation of materials by irradiation with neutrons often permits the detection and quantitative determination of minor components because of the characteristics of the radioisotopes that are produced. In this work, a polonium-beryllium neutron source, containing 5.64 curies polonium was used as the source of neutrons. The thermal neutron

flux was determined by the activation of indium foil and, after suitable corrections, was calculated to be 42,000 neutrons/cm²/sec for the geometry employed. The cadmium ratio was determined in the paraffin block at various distances from the source. Both thermal and fast neutron fluxes are greatest near the source and irradiations should be made with the sample in this position. (auth)

5428 AEC-tr-2173

DOSIMETERS FOR X-RAYS AND GAMMA RAYS. [A. N. Krongaus. Published by Medgiz, Moscow, 1953]. 125p.

The book presents a review of various dosimetric instruments that are being produced in the Soviet Union. To explain the principles of construction of the instruments, brief information is presented on the physics of the atom, of x rays, and of radioactive radiations. (L.M.T.)

5429

MEASUREMENT OF THE CERENKOV RADIATION FROM POSITIVE AND NEGATIVE PI MESONS. J. R. Winckler, E. N. Mitchell, K. A. Anderson, and L. Peterson (Univ. of Minnesota, Minneapolis). *Phys. Rev.* **98**, 1411-15(1955) June 1.

Cherenkov light pulses from individual π^+ and π^- mesons from the Chicago cyclotron have been measured by using photomultipliers and Lucite radiators. An analysis of the pulse-height distributions has been made by comparing the velocity dependence of the radiation with the predictions of classical theory. Theory and experiment are in substantial agreement. However, saturation was found to set in at a somewhat lower energy than theory predicts for an end-window type tube (Dumont type 6363). A search was made for a difference in the photoeffect produced by positive and negative particles radiating Cherenkov light. The effect was found to be less than about 3%, the limit of resolution being determined by magnetic effects on photomultiplier gain. (auth)

5430

AN AUTOMATIC MONITOR FOR MEASURING TRITIUM CONTAMINATION IN AIR. D. F. Shaw (Oxford Univ., England). *J. Sci. Instr.* **32**, 178-80(1955) May.

The design and principle of operation of an automatic monitor for testing air for contamination by tritium is described. The method of detection is based on the measurement of ionization in an air sample. A direct-reading meter registers the level of radioactivity and provision is made for operating a recorder. The instrument was developed to test for tritium contamination but may be used to detect other airborne radioactive gases, e.g. C^{14}O_2 or radon. (auth)

5431

METHODS OF DETECTION FOR ENERGETIC RADIATIONS. Peter Jensen. *Strahlentherapie* **97**, 17-28(1955) May. (In German)

After some general remarks on energetic radiations, their origin and specific ionization, a description is given of the following tools for the detection of energetic radiations: ionization chamber, proportional and Geiger-Müller counter, crystal counter, scintillation counter, cloud chamber, photographic emulsion, and Cherenkov counter. (auth)

5432

ON THE INHERENT WIDTH OF SPECTRAL LINES OF ELECTRON CONVERSION. B. Dzhelepov (Radium Inst., Academy of Sciences, U.S.S.R.). *Doklady Akad. Nauk S.S.S.R.* **101**, 825-8(1955) Apr. 11. (In Russian)

The shape of spectral lines observed in a gamma spectrometer is discussed. (G.Y.)

5433

A SIMPLE D-C FLUOROPHOTOMETER FOR DETECTING URANIUM. Morris F. Milligan and Richard J. Watts (Los Alamos Scientific Lab., N. Mex.). Nucleonics **13**, No. 6, 83-6(1955) June.

An instrument is described which detects the fluorescence of U under ultra-violet light using a U salt fused with sodium fluoride. A diagram is presented of the electronic circuit, a slide-back-voltmeter electrometer-tube cathode-follower type. The preparation of the samples is described. The effects of aging and variations of the ultraviolet light, of sample preparation techniques, and of the sensitivity of the electronic circuit were studied. (M.P.G.)

5434

CdS-CRYSTAL PROBES ARE CONVENIENT FOR DOSIMETRY IN BODY CAVITIES. W. S. Moos and F. Sponberg (Univ. of Illinois Coll. of Medicine, Chicago). Nucleonics **13**, No. 6, 88-90(1955) June.

The smallness and economy of CdS crystals, along with their photoelectric properties and self-contained amplification, make them useful for radiation detection instruments. Since the average size of a crystal is ~ 5 mm long and 1.5 mm in diameter, the crystals can be mounted in probes of very light design for medical radiology. The design of a probe is described. The radiation response is wavelength dependent and varies with the d-c potential applied across the crystal. One disadvantage is the long time needed to reach a stable output current during irradiation. A typical crystal calibration curve and angular dose-rate response are presented. Preliminary results with the crystals indicate good agreement with expected results. (M.P.G.)

5435

MONITOR FOR AIRBORNE ALPHA PARTICLES. D. J. Knowles (Oak Ridge National Lab., Tenn.). Nucleonics **13**, No. 6, 98-103(1955) June.

An instrument is described which continuously monitors air samples for α particles. Dust from 2 air samples is electrostatically precipitated on each side of a moving Al tape. The tape moves between 2 photomultipliers with ZnS screens, and the α activity on both sides is counted. The signals pass through a dual-channel counting-rate meter and subtracting circuit to a strip-chart recorder and audible alarm system. Time lag between collection and alarm is 15 to 20 min. (M.P.G.)

5436

THE CHARACTERISTICS OF TRACKS IN NUCLEAR RESEARCH EMULSIONS. A. J. Herz and G. Davis (Univ. of Sydney, Australia and Imperial Coll. of Science and Tech., London). Australian J. Phys. **8**, 129-35(1955) Mar.

Formulas are derived giving the dependence of the blob, grain, and gap densities, the total gap length, and the mean gap width in the tracks of charged particles as function of the probability of making a silver halide crystal developable. The growth of the grains during the development process is taken into account. The expressions found are suitable for use in discussions of the effects of changes in emulsion properties and they show clearly the differences between the various methods of determining the rate of energy loss from the track characteristics. There is good agreement with experiment for both G5 and C2 emulsion. (auth)

5437

THE DESIGN OF A CONDENSER DOSE-METER. F. Harlen (Metropolitan-Vickers Electrical Co., Ltd, Manchester, England.). Brit. J. Radiol. **28**, 295-303(1955) June.

Factors in the design of instruments for the measurement of x-ray dose are considered with particular reference to a self-contained instrument using a quartz-fibre electroscope. Sufficient theory is given to show how manufacturing tolerances may be accommodated. The design of condenser ionization chambers is also discussed and three chambers are described. Results are given which show their suitability for their intended purpose and attention is given to effects to be expected when they are used at radiation qualities and intensities outside their normal working range. An appendix is devoted to the machining of polystyrene. (auth)

5438

A SUB-STANDARD X-RAY DOSE-METER. Frank T. Farmer (Royal Victoria Infirmary, Newcastle-on-Tyne, England). Brit. J. Radiol. **28**, 304-6(1955) June.

A thimble ionization chamber on the end of a polythene-insulated cable with the inner electrode of the chamber joined directly to the cable core is reported to give good performance when used as a x-ray dose meter. The design and performance characteristics of the instrument are summarized. (C.H.)

5439

IONIZATION CHAMBERS FOR THE DOSIMETRY OF BETA-RAY APPLICATORS. J. L. Haybittle (Addenbrooke's Hospital, Cambridge, England). Brit. J. Radiol. **28**, 320-4(1955) June.

The measurement with ionization chambers of the dose-rate from β -ray applicators is discussed, with special reference to the effect of chamber diameter and the method of deducing the dose-rate at the applicator surface. Measurements on a P^{32} applicator with different types of chambers show that when the diameter of the collecting area in a small, shallow disc-shaped chamber is practically equal to the diameter of the air space in the chamber, significant errors may occur, due to incorrect method of measuring the distance correction, and uncertainty in the extrapolation from the nearest point of measurement to the surface. A chamber of fixed depth, having an air space much larger in diameter than its collecting electrode, will give results in agreement with those obtained with an extrapolation chamber, and may therefore possibly be preferred to an extrapolation chamber in view of its ease of construction and the smaller number of experimental readings required. (auth)

5440

TECHNIQUE OF MICROAUTORADIOGRAPHY FOR METAL SPECIMENS. Robert C. Plumb (Aluminum Research Labs., New Kensington, Penna.). Rev. Sci. Instr. **26**, 489-93 (1955) May.

A microautoradiographic technique which may be used with aluminum alloys is described. It is shown capable of producing a resolution of at least 9 microns with x-radiation and supplying quantitative information as to the distribution of radioactive material in a metallurgical structure. (auth)

5441

PHOTON COUNTERS FOR THE FAR ULTRAVIOLET. T. A. Chubb and H. Friedman (Naval Research Lab., Washington, D. C.). Rev. Sci. Instr. **26**, 493-8(1955) May.
Photosensitive Geiger counters are useful for detection

of ultraviolet radiation between 1050 and 2500 Å. The spectral sensitivities of such photon counters are determined by the photoelectric characteristics of the cathodes and the absorption and photo-ionization properties of the filling gases. Electronegative gases increase the cathode work function and greatly reduce by negative ion formation the probability that a photoelectron will initiate a count. By proper combinations of gases to fix the long wavelength limit of counter sensitivity and filters to limit the short wavelength responses, it is possible to construct relatively narrow band detectors for the extreme ultraviolet. Such tubes have been used to study the solar spectrum from rockets and have been applied in the laboratory to absorption measurements of concentrations of gases such as H_2O in air and O_2 in the presence of H_2 , N_2 , and the rare gases. Characteristics of solid and gaseous materials useful in vacuum ultraviolet work are listed. (auth)

5442

PHOTOTUBE HIGH-INTENSITY GAMMA SURVEY INSTRUMENT. G. E. Koch, H. L. Gottfried, W. R. Lamb, F. A. Rhoads, and J. Valdivia (U. S. Naval Radiological Defense Lab., San Francisco). *Rev. Sci. Instr.* **26**, 499-501 (1955) May.

Many portable γ -radiation detection instruments employing either Geiger tubes or ionization chambers require collection potentials which are large compared to those needed for the operation of the other electronic components. An instrument is described which uses a simple phototube-phosphor combination as the main detecting element with an inverted triode electrometer. It operates at potentials as low as $4\frac{1}{2}$ volts at radiation intensities from 5 mr/hr to 500 r/hr. (auth)

5443

IDENTIFICATION OF CHARGED PARTICLES WITH A CRYSTAL TELESCOPE. B. Wolfe, A. Silverman, and J. W. DeWire (Cornell Univ., Ithaca, N. Y.). *Rev. Sci. Instr.* **26**, 504-10 (1955) May.

An electronic technique is described for identifying nonrelativistic charged particles. The ionization and energy of the particle are measured in a two-crystal telescope, and the product $E(dE/dx)$ is obtained electronically. Since $E(dE/dx) \sim M^{0.8}Z^2$, particles of different mass and/or charge can be separated. (auth)

5444

ABSOLUTE ASSAY OF BETA RADIOACTIVITY IN THICK SOLIDS. APPLICATION TO NATURALLY RADIOACTIVE POTASSIUM. Andrew D. Suttle, Jr. and W. F. Libby (Institute for Nuclear Studies, Chicago). *Anal. Chem.* **27**, 921-7 (1955) June.

The method of absolute measurement of β radioactivity in solids has been found reliable within about 5%. The simplicity of this method and the scarcity of other practical absolute assay techniques led to this study. A wide variety of simple beta emitters display exponential absorption curves when the sample, absorber, and counter are placed close in cylindrical geometry. The absorption coefficient for the material constituting the sample can be used to calculate the absolute specific radioactivity of the solid sample. The absorption coefficients for a given absorbing material vary smoothly with the energy of the beta radioactivity transition, so that reliable values of the energies of such radioactivities can be obtained from the absorption coefficients. The coefficients vary with the atomic weight of the absorber. This effect is only partially elucidated. (auth)

5445

LARGE RECTANGULAR WILSON CHAMBER WITH DOUBLE EXTERNAL EXPANSION. M. I. Daion and V. M. Fedorov. *Zhur. Tekh. Fiz.* **25**, 771-9 (1955) May. (In Russian)

5446

GEOMETRICAL CORRECTIONS TO THE BRAGG-GRAY RELATION APPLIED TO ABSOLUTE CHEMICAL DOSIMETRY. P. J. Dyne (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Can. J. Chem.* **33**, 1109-15 (1955) June.

The γ -ray irradiation conditions for the valid application of the Bragg-Gray relation, which relates the energy deposition in a solid to the ionization in an air-filled cavity, are examined with particular reference to some published experiments on the yield of the radiation-induced oxidation of ferrous sulphate. It is pointed out that experiments in which divergent radiation is used will give a higher oxidation yield than the relation indicates. A quantitative treatment is advanced which accounts for the discrepancies between certain experimental results. (auth)

5447

APPROXIMATE FORMULAS DESCRIBING TRANSMISSION AND ABSORPTION OF BETA RAYS. Erik Odeblad. *Acta Radiol.* **43**, 310-12 (1955) Apr.

Transmission and absorption of beta rays are described by a binomial formula $(1 - r/R)^p$. In this formula, r is the actual and R the maximum range. p denotes an exponent, the value of which, in different cases, was between 2 and 6. (auth)

MESONS

5448 NEVIS-9

Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.

REACTIONS OF STOPPED π^- MESONS IN HYDROGEN AND DEUTERIUM (thesis). William Chinowsky. Apr. 1955. 45p. Sponsored by ONR and AEC under Contract N6-ori-110, Task No. 1. (CU-83-55-ONR-110-1-Phys.)

The capture reactions: (i) $\pi^- + p \rightarrow n + \pi^0$, $\pi^0 \rightarrow 2\gamma$; (ii) $\pi^- + d \rightarrow 2n$; and (iii) $\pi^- + d \rightarrow 2n + \pi^0$, $\pi^0 \rightarrow 2\gamma$ were studied in arrangements where the appropriate reaction products are detected in coincidence with incident negative mesons, some of which come to rest in liquid hydrogen or deuterium. A measurement was made on the angular correlation of the two γ rays emitted in reaction (i). This affords a measure of the π^0 velocity, as did the energy distribution of Panofsky et al., and therefore a new measurement of the $\pi^- - \pi^0$ mass difference. In view of the important consequences of the existence of the second reaction, an experiment was performed to detect the two neutrons in coincidence. This provides a direct observation of the process and confirms the conclusions of Panofsky et al. To determine more precisely the relative rate of reaction (iii), an attempt was made to detect, in coincidence, the two γ rays from the neutral meson decay. The results indicate that the process is highly forbidden and give evidence for pseudoscalar parity of the neutral meson. (auth)

5449 NEVIS-11

Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.

ENERGY DEPENDENCE OF THE PHASE SHIFTS IN PION-PROTON SCATTERING. Jay Orear. May 1955. 16p. Sponsored by ONR and AEC under Contract N6-ori-110, Task No. 1. (CU-8[5]-55-ONR-110-1-Phys.)

It is shown that all pion-proton scattering data up to 300 Mev can be fit within limits of experimental error by using the s waves linearly extrapolated from their low-energy slopes of $\alpha_1 = 0.16\eta$ and $\alpha_3 = 0.11\eta$. All other phase shifts are assumed zero except α_{33} which is given the energy dependence, $\eta^2/\omega^* \cot \alpha_{33} = 8.05 - 3.8 \omega^*$. The two constants in the α_{33} energy dependence fit the initial slope of $\alpha_{33} = 0.235\eta^3$ as determined from low-energy experiments and make α_{33} go through 90° at 192 Mev. According to the cut-off theory this determines a $k_{\max} \approx 6\mu c/\hbar$, corresponding to a pion-nucleon interaction of much shorter range than $\hbar/\mu c$. A theoretical implication of the fit proposed here is that also the s -wave interaction range is considerably less than $\hbar/\mu c$. (auth)

5450 UCRL-3003

California. Univ., Berkeley. Radiation Lab. ANALYSIS OF THE TAU-MESON DECAY AND EVIDENCE FOR THE BETA DECAY OF A K MESON. Harry H. Heckman. May 18. 1955. 9p. Contract W-7405-eng-48.

Secondary particles produced by bombarding a target with 4.8- to 5.7-Bev protons were stopped in Ilford G5 emulsion. Scanning of the tracks in 10.7 cm³ of emulsion disclosed six τ mesons whose decays were consistent with $\tau^+ \rightarrow \pi^+ + 2\pi^+$; evidence for a K electron was found. (auth)

5451 AEC-tr-2179

HYPERONS AS EXCITED STATES OF NUCLEONS. A POSSIBLE MECHANISM OF MULTIPLE FORMATION OF PARTICLES. A. A. Markov. Translated from *Doklady Akad. Nauk S.S.S.R.* 101, 449-52(1955). 6p.

5452 UCRL-Trans-223(L)

FORMATION OF MESONS IN THE REACTION $p + p \rightarrow d + \pi^+$ IN THE REGION 510-660 MEV. M. G. Meshcheryakov and B. S. Neganov. Translated by S. Shewchuck from *Doklady Akad. Nauk S.S.S.R.* 100, 677-9(1955). 5p.

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 9-3606.

5453 UCRL-Trans-224(L)

FORMATION OF π -MESONS BY PROTONS WITH 670 MEV ENERGY ON NUCLEI OF DIFFERENT ELEMENTS. A. A. Tyapkin, M. S. Kozodaev, and Yu. D. Prokoshkin. Translated by S. Shewchuck from *Doklady Akad. Nauk S.S.S.R.* 100, 689-92(1955). 7p.

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 9-3607.

5454

CONVERSION OF TWO PHOTONS INTO A π^0 MESON AND PRODUCTION OF π^0 MESONS IN THE COMPTON EFFECT. A. Ya. Temkin. *Zhur. Eksptl'. i Teoret. Fiz.* 26, 645-6 (1954) May. (In Russian)

5455

OBSERVATIONS ON HEAVY MESONS AND HYPERONS. *Nature* 175, 971-3(1955) June 4.

5456

SELECTION RULES FOR MESON DECAYS INTO TWO BOSONS IMPOSED BY THE CONSERVATION OF ANGULAR MOMENTUM AND PARITY. Borivoj Jakšić. *Soc. Sci. Nat. Croat. Period. Math.-Phys. et Astron. Ser. II* 9, No. 1, 27-33 (1954). (In English)

A complete list of selection rules is derived for decays into 2 bosons of any kind. Use is made of Michel's group-theoretical method for cases of vanishing and nonvanishing mass. The selection rules do not depend upon the nature of

the particles involved and therefore can be used for nuclei. (M.P.G.)

5457

SELECTION RULES FOR DECAYS INTO SPIN 0 AND POLARIZED SPIN 1 PARTICLES DUE TO THE CONSERVATION OF ANGULAR MOMENTUM AND PARITY. Borivoj Jakšić. *Soc. Sci. Nat. Croat. Period. Math.-Phys. et Astron. Ser. II* 9, No. 2, 81-7(1954). (In English)

A list of selection rules is derived for decays into a number of polarized spin 0 and spin 1 particles. The method of constructing all possible wave functions is used. Only 2-boson decays are considered. (M.P.G.)

5458

PRODUCTION OF CHARGED PIONS IN N-P COLLISIONS. Gaurang B. Yodh (Inst. for Nuclear Studies, Chicago). *Phys. Rev.* 98, 1330-47(1955) June 1.

The differential cross section and energy spectra for the production of π^\pm mesons by the 400-Mev neutron beam of the Chicago synchrocyclotron on liquid hydrogen has been measured at 90° and 65° in the laboratory, using photographic emulsions as detectors. At 65° (corresponding to 90° in the center-of-mass system), roughly equal numbers of positive and negative pions were observed, while at 90° the ratio of positive to negative pions was found to be 2.01 ± 0.24 . The laboratory integrated cross sections ($d\sigma_{\text{Av}}/d\Omega$)_{Av}, in cm²/sterad, are: for π^+ at 90° $(2.296 \pm 0.363) \times 10^{-23}$, for $T > 14$ Mev; for π^- at 90° , $(1.56 \pm 0.357) \times 10^{-23}$, for $T > 14$ Mev; for π^+ at 65° , $(1.22 \pm 0.30) \times 10^{-23}$, for $T > 41$ Mev; and for π^- at 65° , $(1.31 \pm 0.63) \times 10^{-23}$. These experimental cross sections are the result of production due to neutrons of all energies above the threshold for pion production in the neutron beam. A phenomenological analysis is made for the reaction $N + p \rightarrow \pi^\pm$ under the hypothesis of charge independence and the energy and angular distributions of the pions at a single neutron energy are deduced from the experimental cross sections. The total cross section for π^+ or π^- production, at neutron energy 409 Mev, is determined to be $\sigma(\pi^+) = \sigma(\pi^-) = 0.16 \pm 0.04$ millibarn, and the differential cross section for the same neutron energy is calculated to be

$$(d\sigma/d\omega)^\pm = (1.07 \pm 0.39) + (1.38 \pm 0.78) \cos\theta + (0.57 \pm 1.14) \cos^2\theta \times 10^{-23} \text{ cm}^2/\text{sterad. (auth)}$$

5459

DIFFUSION CLOUD-CHAMBER STUDY OF VERY SLOW MESONS. I. INTERNAL PAIR FORMATION. C. P. Sargent, R. Cornelius, M. Rinehart, L. M. Lederman, and K. Rogers (Columbia Univ., New York). *Phys. Rev.* 98, 1349-54(1955) June 1.

A beam of negative pi and mu mesons was moderated to very low energies and allowed to enter a hydrogen-filled 20-atmosphere continuously sensitive cloud chamber. The various phenomena were observed and classified. A detailed study was made of the internal pair formation of mesonic gamma rays produced in the pion-hydrogen reactions. The conversion coefficient for the reaction $\pi^0 \rightarrow \gamma + e^+ + e^-$ was found to be 0.0053 ± 0.0009 ; for the reaction $\pi^- + p \rightarrow n + e^+ + e^-$ the coefficient is 0.0062 ± 0.0013 . Distributions in angle and energy were obtained from thirty-five of the forty-seven observed cases. (auth)

5460

INTERNAL PAIR PRODUCTION ASSOCIATED WITH THE EMISSION OF HIGH-ENERGY GAMMA RAYS. Norman M.

Kroll (Columbia Univ., New York) and Walter Wada (Naval Research Labs., Washington, D. C.). *Phys. Rev.* **98**, 1355-9(1955) June 1.

The theory of inner pair production associated with the radiative capture of π^- mesons and with the decay of the π^0 meson is discussed. Appropriate distribution functions are derived and compared with recently obtained experimental results. The weak dependence of the theoretical predictions upon the details of meson theory is emphasized. The possible utility of the double conversion process, in which the π^0 meson decays into two electron-positron pairs, for the determination of the π^0 parity is also discussed. (auth)

5461

$\Lambda^0 - \theta^0$ PRODUCTION IN $\pi^- - P$ COLLISIONS AT 1 BEV. W. D. Walker (Univ. of Wisconsin, Madison). *Phys. Rev.* **98**, 1407-10(1955) June 1.

Two examples of $\Lambda^0 - \theta^0$ production have been found in the collision of 1.0-Bev π^- mesons with protons. Data on these two cases are given. The two cases are qualitatively similar, yet there are quantitative differences in terms of the angles of production of the θ^0 and Λ^0 particles. One case is internally consistent with the production of a Λ^0 and θ^0 directly. The other case, in which the Λ^0 and θ^0 particles seem slightly noncoplanar with the incoming π^- meson, is not internally consistent with the direct production of a Λ^0 and θ^0 . It is likely that either the θ^0 or the Λ^0 or both θ^0 and Λ^0 are the products of decay of heavier parents. It is also possible that a light particle (γ or ν) may be produced simultaneously with the θ^0 and Λ^0 . If one supposes that the Λ^0 is the product of decay of a heavier parent then the Q of such a parent, were it to decay into a proton and π^- meson, is calculated to be 117 ± 30 Mev. This Q value is close to that of the charged hyperons. A short-lived neutral hyperon of this mass has been predicted by Gell-Mann. (auth)

5462

NATURE OF THE NEUTRAL SECONDARY PARTICLE PRODUCED IN THE DECAY OF THE $K_{\pi 2}$ -MESON. Herbert DeStaebler, Jr. and B. V. Sreekantan (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **98**, 1520-1(1955) June 1.

Data are presented on five S events obtained with a multi-plate cloud chamber which can be interpreted according to the scheme $K_{\pi 2} \rightarrow \pi + \pi^0$. (L.M.T.)

NEUTRONS

5463 HW-32058

Hanford Atomic Products Operation, Richland, Wash. NEUTRON DIFFUSION AND RANDOM WALK. G. E. Duvall. [1954?]. Decl. Dec. 28, 1954. 14p. Contract [W-31-109-Eng-52].

The progress of a neutron through a moderator is explored by calculating from the theory of probability the behavior of a single particle in an infinitely extended medium. From this result and the theory of stochastic processes the average solution is then obtained. By following the procedure correctly, results may be obtained which agree with those from the transport equation. (L.M.T.)

NUCLEAR PHYSICS

5464

SHELL THEORY OF THE NUCLEUS. Eugene Feenberg. Princeton University Press, 1955. 211p. \$4.00.

The second stage in the development of the understanding of nuclear shell structure embraced the explicit formulation of systematic shell models and the application of these models to interpret spins and parities, magnetic dipole and electric quadrupole moments, isomerism, and β decay over the whole range of nuclear species. This monograph supplies a guide to this development for readers who are familiar with the elements of nuclear physics and quantum theory. (L.M.T.)

5465

THE STRUCTURE OF THE NUCLEI OF MASS 18 AND 19. J. P. Elliott and B. H. Flowers (Atomic Energy Research Establishment, Harwell, Berks, England). *Proc. Roy. Soc. (London)* **A229**, 536-63(1955) May 24.

An intermediate coupling calculation has been carried out for nuclei of mass 18 and 19, taking full account of the configurational mixing of the 2s and 1d shells. The spin-orbit splitting of the d-level and the relative position of the s-level are taken from the observed O^{17} spectrum, while the strength of the two-body central force is treated as a free parameter. No excitation of the O^{16} closed shell core is considered. Excellent agreement is found for the positions of the even-parity energy levels and their properties, including the reaction data. The configurational mixing is very large, the strength of central force is similar to that required for the deuteron, and the mode of coupling is similar to that in the lithium nuclei. (auth)

5466

MASSES OF NUCLEI IN ISOBARIC SEQUENCES. Kailash Kumar and M. A. Preston (McMaster Univ., Hamilton, Ontario, Canada). *Can. J. Phys.* **33**, 298-315(1955) June.

The semiempirical mass formula is known to give a rough fit to the general trend of atomic masses. A detailed correlation to within 0.5 Mev or less is attempted between observed atomic mass differences and the predictions of a semiempirical liquid drop formula generalized to include terms which depend on angular momentum in the way suggested by the nuclear shell model. For fixed A, it is found that, allowing for these "spin terms", the Z dependence is parabolic. The variations of the different parameters with A and with shell changes are studied. It is found that, when close agreement with experimental values of mass is required, certain "constants" of the liquid drop formula are in fact quite dependent on A. This is interpreted to mean that the A or Z dependence of the formula is incomplete. Nevertheless, an empirical method of extrapolating unknown masses is suggested. (auth)

5467

HIGH-ENERGY REACTIONS AND THE EVIDENCE FOR CORRELATIONS IN THE NUCLEAR GROUND-STATE WAVE FUNCTION. K. A. Brueckner, R. J. Eden, and N. C. Francis (Indiana Univ., Bloomington). *Phys. Rev.* **98**, 1445-55(1955) June 1.

High-energy nuclear reactions which depend strongly on nucleon position correlations in the nuclear ground state are analyzed and shown to give evidence for the existence of marked correlation effects. The following high-energy experiments are considered: nuclear photoeffect, meson absorption in nuclei, deuteron pickup, proton-proton scattering in a nucleus, and meson production in proton-nucleus collisions. The corresponding cross sections depend on a nucleon momentum distribution which can be represented at high energies by a single function giving reasonable agreement with all the experiments considered. This momentum distribution

bution differs substantially from that for the shell model of the nucleus and thus provides strong evidence for correlation in the nuclear ground-state wave function. The transformation methods developed in previous papers are used to provide a unified theory of the above five processes. The momentum distribution predicted by this theory is estimated by two methods each of which gives close agreement with the experimentally determined function in the relevant energy ranges. (auth)

5468

DEUTERON REACTIONS AND THE j - j COUPLING SHELL MODEL. J. B. Franch and B. J. Raz (Univ. of Rochester, N. Y.). *Phys. Rev.* 98, 1523-4(1955) June 1.

The utility of a particular class of deuteron stripping and pickup reactions in measuring one type of departure from the j - j coupling shell model in certain nuclei is discussed. (auth)

5469

EVALUATION OF THE IMAGINARY PART OF THE NUCLEAR COMPLEX POTENTIAL. A. M. Lane and C. F. Wandel (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* 98, 1524-5(1955) June 1.

Neutron scattering data for several incident energies have been analyzed fairly successfully with a simple complex potential model [Weisskopf and Friedman (to be published)]. An estimation of V_i , the imaginary part of the potential, is estimated in this note, using a method proposed by Goldberger (*Phys. Rev.* 74, 1269(1948)) for high incident energies. (L.M.T.)

NUCLEAR PROPERTIES

5470

AN INVESTIGATION OF THE NUCLEAR RESONANCE ABSORPTION SPECTRUM OF Al^{27} IN A SINGLE CRYSTAL OF EUCLASE. R. G. Eades (Univ. of British Columbia, Vancouver). *Can. J. Phys.* 33, 286-97(1955) June.

The nuclear magnetic resonance spectrum of Al^{27} in a single crystal of HBeAlSiO_5 (euclase) in an external magnetic field of 7000 gauss is described. The Al^{27} nuclei are found to occupy two kinds of lattice sites which differ from each other only in the orientation of the principal axes of the electric field gradient tensors whose eigenvalues are all distinct, but identical at both sites. The absolute value of the quadrupole coupling constant for both groups of Al^{27} nuclei is found to be 5173 ± 10 kc/sec and the axial asymmetry parameter of the field gradient tensors at both the lattice positions is 0.698 ± 0.009 . The two sets of principal axes are reflections of each other in the (010) plane which is consistent with the symmetry of the proposed crystal structure. The theoretical dependence of the spectrum line frequencies on the applied magnetic field is given for one group of Al^{27} nuclei and for one orientation of the crystal in fields up to 2000 gauss; the feasibility of checking this experimentally is discussed. (auth)

5471

ANALYSIS OF SPIN-SPIN MULTIPLTS IN NUCLEAR MAGNETIC RESONANCE SPECTRA. H. M. McConnell, A. D. McLean, and C. A. Reilly (Shell Development Co., Emeryville, Calif.). *J. Chem. Phys.* 23, 1152-9(1955) June.

A systematic procedure is developed for the analysis of the spin-spin multiplets that are observed in the high-resolution NMR (nuclear magnetic resonance) spectra of liquids. It is shown how the symmetry properties of nuclear

spin functions can be used to simplify the interpretation of NMR multiplets in terms of the empirical quantities, chemical shifts, and spin-spin coupling constants. It is also pointed out that when NMR multiplets have been properly interpreted in terms of these empirical quantities, it is then possible to predict theoretically relative intensities of multiplets to the same degree of precision as that involved in the measurement of multiplet frequency separations. As an example the multiplet splittings of the H^1 and F^{19} resonances in 1,1-difluoroethylene are analyzed using the procedure proposed. (auth)

5472

NUCLEAR QUADRUPOLE RESONANCES OF Sb^{121} AND Sb^{123} . R. G. Barnes (Univ. of Delaware, Newark) and P. J. Bray (Rensselaer Polytechnic Inst., Troy, N. Y.). *J. Chem. Phys.* 23, 1177-8(1955) June.

$\text{Sb}^{121,123}$ resonances for Sb_2O_3 , $\text{Sb}(\text{C}_2\text{H}_5)_3$, $\text{Sb}(\text{C}_2\text{H}_5\text{O})_3$, and SbCl_3 and I^{127} resonances for BiI_3 and SbI_3 are reported. Measured frequencies and signal-to-noise ratios are listed and coupling constants and asymmetry parameters as functions of temperature are evaluated. (C.W.H.)

5473

ERRATUM: NUCLEAR QUADRUPOLE RESONANCES OF As^{75} . R. G. Barnes (Univ. of Delaware, Newark) and P. J. Bray (Rensselaer Polytechnic Inst., Troy, N. Y.). *J. Chem. Phys.* 23, 1178(1955) June. (cf. NSA 9-2900)

As^{75} resonances for AsCl_3 at 147 and 195°K are reported. A new value for the As^{75} resonance for AsBr_3 was determined. (C.W.H.)

5474

SPIN, QUADRUPOLE MOMENT, AND MASS OF SELENIUM-75. L. C. Aamodt and P. C. Fletcher (Columbia Univ., New York). *Phys. Rev.* 98, 1224-9(1955) June 1.

The microwave spectrum of OCSe^{75} has been observed and from it the spin, quadrupole moment, and mass of Se^{76} were measured. Frequencies of the six observed lines of the $J = 2 \rightarrow 3$ rotational transition give a nuclear spin of $5/2$, a quadrupole coupling constant $eQq = 946.0$ Mc/sec, and a rotational constant $B_0 = 4081.926$ Mc/sec. From these and other known properties of the OCSe molecule, one obtains the quadrupole moment of Se^{76} as $Q = 1.1 \times 10^{-24} \text{ cm}^2 \pm 20$ percent, and the mass ratio $(M_{\text{Se}^{76}} - M_{\text{Se}^{75}})/(M_{\text{Se}^{76}} + M_{\text{Se}^{75}}) = 0.199566 \pm 0.000030$. The odd-even mass difference for Se^{75} is 1.5 ± 0.2 mMU. (auth)

5475

RADIATIONS OF I^{126} . L. Koerts, P. Macklin, B. Farrelly, R. van Lieshout, and C. S. Wu (Columbia Univ., New York). *Phys. Rev.* 98, 1230-7(1955) June 1.

The β and γ radiations and the electron capture process of I^{126} have been thoroughly investigated. The β^- branch consists of three groups of maximum energies 1.25, 0.865, and 0.385 Mev. The relative intensities of these three β^- groups are 1:3.1:0.63 respectively. The shape of the highest energy β^- group identifies the ground to ground transition to be a unique first forbidden one ($\Delta J = 2$, yes). The spectrum of the middle β^- group as measured by the magnetic coincidence spectrometer has an allowed shape. The number of β^+ disintegrations is only 2.8% of that of the β^- disintegration. Two groups of maximum energies 1.11 and 0.46 Mev were found with an intensity ratio of 3.5:1. The shape of the β^+ spectrum of the ground to ground transition is also the unique first forbidden type. The correlations among the various γ lines and x line and their relative intensities are determined

by a selective coincidence scintillation spectrometer. In conclusion, the spin and parity of the 1^{126} ground state is definitely 2^- , and its decay scheme is in general agreement with that of Perlman and Welker. (auth)

5476

ELECTRIC EXCITATION OF CERTAIN MEDIUM-WEIGHT NUCLEI BY PROTONS. Hans Mark, Clyde McClelland, and Clark Goodman (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **98**, 1245-51(1955) June 1.

Electric excitation has been used to study energy levels in 16 elements ranging from scandium to iodine. Seventeen γ rays have been observed. Electric quadrupole transition probabilities for the energy levels corresponding to these γ rays have been calculated from the measured electric-excitation cross sections. The results are substantially larger than those expected from transitions of single particles but are significantly and uniformly lower than those calculated from the energies of the levels by using the hypothesis of rotational excitation. Similar observations have been made previously for a series of heavy nuclei. It is suggested that this effect results from either a nonuniform distribution of charge and mass in the nucleus or from a breakdown of the assumption that the collective motion can be represented as an irrotational flow. (auth)

5477

RADIATION WIDTH VARIATIONS IN THE SLOW-NEUTRON RESONANCES OF EUROPIUM AND INDIUM. H. H. Landon and V. L. Sailor (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **98**, 1267-71(1955) June 1.

The parameters of the lowest-energy resonances in europium and indium have been determined from total cross section measurements using the Brookhaven crystal spectrometer. The data have been analyzed for variations in the radiation width parameter Γ_γ from resonance to resonance. The method of analysis used to take account of Doppler effect in the observed cross section is discussed. The radiation width in the 0.327-ev resonance in Eu is 70 ± 10 mv, which is definitely smaller than that for the 0.461-ev and 1.056-ev resonances which are respectively 93 ± 3 mv and 94 ± 3 mv. The widths of the 1.456-ev and 3.85-ev resonances in In are 72 ± 2 mv and 81 ± 4 mv respectively. The remaining one-level parameters for each resonance are also presented. (auth)

5478

MODEL FOR ASYMMETRIC FISSION. R. D. Hill (Univ. of Illinois, Urbana). *Phys. Rev.* **98**, 1272-6(1955) June 1.

On the basis of shell effects, asymmetric fission is attributed to symmetrical division except for a non-fissionable core. Distributions of fission-fragment yields, vs. fragment charges and masses, are obtained from simple statistical considerations of the division. (auth)

5479

ELECTRIC MONOPOLE TRANSITIONS IN C^{12} AND O^{16} . L. I. Schiff (Stanford Univ., Calif.). *Phys. Rev.* **98**, 1281-5 (1955) June 1.

The matrix elements for the electric monopole ($0^+ \rightarrow 0^+$) transitions between the ground and 7.68-Mev state in C^{12} and between the ground and 6.06-Mev state in O^{16} may be estimated from inelastic electron scattering and from the pair emission lifetime, respectively. The two are equal to each other within the rather large error of the electron scattering determination, and are given by $(\Sigma p r_p^2)_{f0} \approx 3.8 \times 10^{-28} \text{ cm}^2$, where 0 and f represent initial and final states of the nucleus,

and r_p is the radial distance of a proton from the center of the nucleus. Calculations based on the alpha-particle model and on an elastic-fluid model yield three to five times this experimental value. Therefore, a calculation was made in the case of C^{12} , based on the jj-coupling independent-particle model, according to which two nucleons undergo transitions between the $p_{3/2}$ shell and the $p_{1/2}$ shell. The matrix element vanishes if there are no internucleon forces. Pair forces are included to first order, and the sum over configurations is performed exactly by means of a Green's function. For simplicity it is assumed that the independent-particle potential is an infinitely deep square well, and that the pair interaction has zero range. Even assuming that the pair interaction has its free-space triplet magnitude, the calculated matrix element is only about one-sixth the experimental value. It is concluded, therefore, that a model that is more collective than the independent-particle model with pair intercollective than the independent-particle model with pair interactions, and less collective than the alpha-particle or elastic-fluid models, is required to account for the experimental results. (auth)

5480

NUCLEAR MOMENTS OF Nb^{93} , La^{139} , Os^{187} , AND Hg^{201} . Kiyoshi Murakawa (Inst. of Science and Tech., Tokyo, Japan). *Phys. Rev.* **98**, 1285-8(1955) June 1.

The effective charge Z^* for a d-electron was studied by means of a hyperfine structure (hfs) investigation; the screening correction ($Z - Z^*$) was found to range from 15 to about 19 for the charge number Z ranging from 27 to 78. Investigation of the hfs of the spectra of $Nb I$ and $La I$ yielded the result that $Q(Nb^{93}) = (-0.2 \pm 0.1) \times 10^{-24} \text{ cm}^2$ and $Q(La^{139}) = (+0.6 \pm 0.2) \times 10^{-24} \text{ cm}^2$, respectively, in which the polarization correction (due to Sternheimer) is taken into account. In the hfs of the spectrum of $Os I$ the components due to the rarer odd isotope Os^{187} were detected and it was found that Os^{187} has a spin $1/2$ and a magnetic moment most probably equal to $+0.12 \text{ nm}$ (possible range being from $+0.16$ to $+0.09 \text{ nm}$). The quadrupole moment of Hg^{201} was calculated from the hfs of $6s6p^1P_1$ and $6s6p^3P_2$ of the spectrum of $Hg I$, taking the configuration interaction into account, and $Q(Hg^{201}) = (+0.45 \pm 0.04) \times 10^{-24} \text{ cm}^2$ was obtained. (auth)

5481

PHOTONEUTRON CROSS SECTIONS IN Mg^{24} , Mg^{25} , Zr^{90} , Zr^{91} . Robert Nathans and Paul F. Yergin (Univ. of Pennsylvania, Philadelphia). *Phys. Rev.* **98**, 1296-9(1955) June 1.

The variation of $\sigma(\gamma, n)$ with E_γ from threshold to 24 Mev has been measured by detecting neutrons produced from betatron bremsstrahlung irradiation of separated isotope samples in oxide form. Despite the large threshold differences (9.3 Mev for the Mg isotopes and 5.0 Mev for the Zr isotopes) the peaks of the giant dipole resonances are very close for each pair of adjacent isotopes: Mg^{24} , 19.5 Mev; Mg^{25} , 20.3 Mev; Zr^{90} , 16.4 Mev; Zr^{91} , 16.3 Mev. The half-widths of the Zr resonances are unusually small, 4.1 and 5.4 Mev, compared to 8 Mev for nearby nuclei observed previously. This is apparently a "magic number" effect. (auth)

5482

THRESHOLD VALUES OF INTERNAL CONVERSION COEFFICIENTS FOR THE K-SHELL. B. I. Spinrad (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **98**, 1302-4(1955) June 1.

Corrected relativistic calculations for the internal con-

version coefficients of K-shell electrons at threshold energies of the gamma rays are presented. A comparison is made with nonrelativistic formulas. (auth)

5483

PROPERTIES OF EXCITED STATES OF Pd AND Cd NUCLEI BY COULOMB EXCITATION. G. M. Temmer and N. P. Heydenburg (Carnegie Institution of Washington, D. C.). *Phys. Rev.* 98, 1308-10(1955) June 1.

The first-excited (2^+) states of most even-even nuclei of Pd and Cd were coulomb-excited using enriched targets. Three of these states were previously unknown (Pd^{106} , Pd^{110} , and Cd^{116}). Excited states in Pd^{106} , Cd^{111} , and Cd^{113} were also observed, the latter yielding a new level at 290 kev. Transition probabilities (lifetimes) for these transitions have been determined and show definite systematic trends. (auth)

5484

NUCLEAR MAGNETIC MOMENTS OF Cl^{36} , Rh^{103} , AND W^{183} . P. B. Sogo and C. D. Jeffries (Univ. of California, Berkeley). *Phys. Rev.* 98, 1316-17(1955) June 1.

The nuclear magnetic resonance of Cl^{36} in HCl solution has been observed by nuclear induction, and the magnetic moment is found to be $\mu(\text{Cl}^{36}) = +1.2838 \pm 0.0002$ nm. Calculations on a jj coupling model yield $\mu(\text{Cl}^{36}) = +1.16$ nm. The magnetic resonances of Rh^{103} and W^{183} have been observed in powdered metallic samples. The magnetic moments are found to be $\mu(\text{Rh}^{103}) = -0.08790 \pm 0.00007$ nm, and $\mu(\text{W}^{183}) = +0.115 \pm 0.001$ nm, where in each case a calculated correction for the Knight shift due to the conduction electrons has been applied. (auth)

5485

MAGNETIC MOMENT AND MASS OF CHLORINE-36. L. C. Aamodt and P. C. Fletcher (Columbia Univ., New York). *Phys. Rev.* 98, 1317-23(1955) June 1.

The magnetic moment of the Cl^{36} nucleus was measured by observing the Zeeman splitting of the $F = 2 \rightarrow 2$ line in the electric quadrupole hyperfine pattern of the molecule $\text{CH}_3\text{Cl}^{36}$ ($J = 0 \rightarrow 1$, $K = 0$ transitions). It was found to be 1.32 ± 0.08 nuclear magnetons. The magnitude of the magnetic moment was measured by using a rectangularly cross-sectioned absorption cell with plane polarized microwave radiation, and observing the $\Delta M = \pm 1$ transitions. The sign of the magnetic moment was measured by using a circularly cross-sectioned absorption cell with circularly polarized microwave radiation. This allowed the $\Delta M = 1$ and the $\Delta M = -1$ transitions to be observed separately. The magnetic field was calibrated by observing the Zeeman splitting of the spectrum of $\text{CH}_3\text{Cl}^{35}$. This value of magnetic moment indicates a nuclear configuration $(d_{3/2})_N (d_{3/2})_P$. Measurements of the quadrupole spectrum without the Zeeman perturbation gave the following additional information: the spin of Cl^{36} was confirmed to be 2, the mass difference ratio $[m(\text{Cl}^{36}) - m(\text{Cl}^{35})]/[m(\text{Cl}^{37}) - m(\text{Cl}^{36})]$ was found to be 1.00168 ± 0.04 percent, the molecular rotational constant of the $\text{CH}_3\text{Cl}^{36}$ molecule was found to be 13187.604 ± 0.015 Mc/sec, and its quadrupole coupling constant to be -15.83 ± 0.20 Mc/sec. (auth)

5486

NUCLEAR CROSS SECTIONS FOR 1.4-BEV NEUTRONS. T. Coor, D. A. Hill, W. F. Hornyak, L. W. Smith, and G. Snow (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* 98, 1369-86(1955) June 1.

Transmission measurements in good and poor geometry have been performed at the Brookhaven Cosmotron to meas-

ure the total and absorption cross sections of several nuclei for neutrons in the Bev energy range. The neutrons are produced by bombarding a Be target with 2.2-Bev protons. The neutron detector requires the incident particle to pass an anticoincidence counter and produce in an aluminum radiator a charged particle that will traverse a fourfold scintillation telescope containing 6 in. of lead. Contribution of neutrons below 800 Mev are believed small. The angular distribution of neutrons from the target is sharply peaked forward with a half-width of 6° . The integral angular distributions of diffraction scattered neutrons from C, Cu, and Pb are measured by varying the detector geometry. The angular half-width of these distributions indicates a mean effective neutron energy of 1.4 ± 0.2 Bev. The total cross sections σ_H and $\sigma_D - \sigma_H$ are measured by attenuation differences in good geometry of $\text{CH}_2 - \text{C}$ and $\text{D}_2\text{O} - \text{H}_2\text{O}$, with the result: $\sigma_H = 42.4 \pm 1.8$ mb, $\sigma_D - \sigma_H = 42.2 \pm 1.8$ mb. The cross sections of eight elements from Be to U are measured in good and poor geometry, and values of the total and absorption cross sections are deduced. An interpretation of these cross sections is given in terms of optical model parameters for two extreme nuclear density distributions: uniform (radius R) and Gaussian [$\rho = \rho_0 \exp - (r/a)^2$]. The absorption cross-section data are well fitted with $R = 1.28A^{1/3}$ or $a = 0.32 + 0.62A^{1/3}$ in units of 10^{-13} cm. A nuclear density distribution intermediate between uniform and Gaussian will make the present results consistent with the recent electromagnetic radii. (auth)

5487

HIGH-ENERGY CROSS SECTIONS. I. THE SIZE OF THE NUCLEUS. Robert W. Williams (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* 98, 1387-92(1955) June 1.

An analysis is made of the available measurements of the absorption (reaction) cross sections of nuclei for 1.4-Bev neutrons. The nature of the approximations involved in interpreting such data is discussed, and it is pointed out that these measurements are more directly related to the nuclear density distribution than are the lower-energy measurements. If it is assumed that the density drops off smoothly to zero at the edge of the nucleus, in accord with electron scattering results, it is found that the size of the nucleus determined from these nuclear experiments is in good agreement with the size determined from electromagnetic experiments. This fact indicates that the spatial distribution of the protons is probably equal to that of the neutrons, and cannot be smaller by as much as 1×10^{-13} cm, even for heavy nuclei. A simple formula is given for the nuclear density distribution; the radius of the uniform (square-well) density distribution which yields the same $\langle r^2 \rangle_{Av}$ is $r_0 = 1.19A^{1/3} \times 10^{-13}$ cm; the corresponding square-well radius for nuclear interactions is larger, and depends on the type and energy of observation. Some results are presented of a method for treating the effect of the finite range of interaction of the neutrons. (auth)

5488

HIGH-ENERGY CROSS SECTIONS. II. NUCLEON-NUCLEON CROSS SECTION AT COSMIC-RAY ENERGIES. Robert W. Williams (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* 98, 1393-7(1955) June 1.

Cosmic-ray measurements are capable of yielding reliable results for the cross section of a nucleus for proton or neutron collisions involving a not too small energy transfer. This cross section should therefore be less than, or at most equal to, the true nonelastic cross section (reaction cross

section). Results of recent cosmic-ray work are assembled and compared with the reaction cross sections measured at 1.4 Bev with the Brookhaven Cosmotron; it is found that the cosmic-ray cross sections are significantly larger, even for Pb. Assuming a nonuniform distribution of the density of nuclear matter, one can explain this surprising effect as the result of an increase in the elementary nucleon-nucleon cross section with energy. It is shown that the elementary cross section (the average of σ_{pp} and σ_{np}) must be $(120^{+30}_{-20}) \times 10^{-27} \text{ cm}^2$ in the neighborhood of 30 Bev. (auth)

5489

"BRUTE FORCE" POLARIZATION OF In^{115} NUCLEI; ANGULAR MOMENTUM OF 1.458-EV NEUTRON RESONANCE. J. W. T. Dabbs, L. D. Roberts, and S. Bernstein (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **98**, 1512-13(1955) June 1.

5490

NUCLEAR MOMENTS OF Ac^{227} . Mark Fred and Frank S. Tomkins (Argonne National Lab., Lemont, Ill.) and William F. Meggers (National Bureau of Standards, Washington, D. C.). *Phys. Rev.* **98**, 1514(1955) June 1.

Values found for the nuclear magnetic dipole and electric quadrupole moments from the conventional treatment of hfs in intermediate coupling are $+1.1 \text{ nm}$ and $-1.7 \times 10^{-24} \text{ cm}^2$, respectively. (L.M.T.)

5491

PREDICTED $0+$ LEVEL IN $_{40}\text{Zr}^{90}$. Kenneth W. Ford (Indiana Univ., Bloomington). *Phys. Rev.* **98**, 1516-17(1955) June 1.

A recently discovered high-energy isomeric transition in Zr^{90} produced evidence that the subshell of 40 protons behaves like a closed shell. This leads to the expectation that the first excited state might be a $0+$, and the evidence for this level is discussed in this note. (L.M.T.)

5492

EVIDENCE FOR A $0+$ FIRST EXCITED STATE IN Zr^{90} . O. E. Johnson, R. G. Johnson, and L. M. Langer (Indiana Univ., Bloomington). *Phys. Rev.* **98**, 1517-18(1955) June 1.

Very precise measurements on the β spectrum of Y^{90} gave no indication of any other group of β rays between 0.5 and 2.26 Mev. This fact, combined with the absence of any γ radiation (other than bremsstrahlung) suggests that the 1.75-Mev level is the first excited state of Zr^{90} . (auth)

NUCLEAR REACTORS

5493 BNL-334

Brookhaven National Lab., Upton, N. Y.

THEORY OF LOW POWER KINETICS OF CIRCULATING FUEL REACTORS WITH SEVERAL GROUPS OF DELAYED NEUTRONS. J. A. Fleck, Jr. Apr 1955. 21p.

A method is described for computing reactor periods of circulating fuel reactors by finding the eigenvalues of a system of differential equations. The method accommodates two energy groups of neutrons and five groups of delayed neutrons. Approximate inhour equations are also derived for flat and sinusoidal fluxes and compared with the eigenvalue method. Discrepancies are largely attributable to differences in the delayed neutron spatial distribution. (auth)

5494

ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANTS. SITE SELECTION AND PLANT LAYOUT. S. M. Stoller (Vitro Corp. of America, New York). *Nucleonics* **13**, No. 6, 42-5(1955) June.

The choice of site and layout for a nuclear power plant is influenced by the necessity of producing power competitively with conventionally fueled facilities and by the operating conditions, function, and size of the plant. Because of the high cost of power transmission, many nuclear power plants will be located close to populated areas. Safety and waste disposal provisions are therefore major considerations. Special layout considerations for pressurized water, boiling water, aqueous homogeneous, fast breeder, sodium graphite, and gas cooled reactors are summarized. (M.P.G.)

5495

ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANTS. WATER SUPPLIES FOR REACTORS. H. W. Huntley and S. Untermyer (General Electric Co., Schenectady, N. Y.). *Nucleonics* **13**, No. 6, 46-7(1955) June.

Nuclear power plants have lower thermal efficiencies than modern conventionally fueled steam plants and require more cooling water for the same electric output. A typical nuclear power plant utilizing a pressurized water reactor may have 3 separate water systems: condenser cooling water; boiler feed water; and reactor cooling water. Condenser circulating water requires only conventional antifouling treatment since it normally does not become radioactive. High standards of purity are required for boiler water to minimize scale formation in the highly radioactive boiler. Primary cooling water must be exceedingly pure since impurities in the water may become activated. Purification plants for primary cooling water are discussed. (M.P.G.)

5496

ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANTS. CONTROL-ROD MECHANISMS. J. M. Harrer (Argonne National Lab., Lemont, Ill.). *Nucleonics* **13**, No. 6, 48-51(1955) June.

The design of drive mechanisms for reactor control rods is strongly affected by the reactor type. General drive requirements include specifications on control rod speed, position, position indicators, and safety release. The basic mechanisms used to drive control rods are rack and pinion, lead screw and nut, ball-bearing screw jack, and hydraulic or pneumatic piston. Special design considerations must be given to the drive rod, mechanism travel and spacing, motors, position measurement, and safety releases such as magnetic latches. Drive seals are sometimes necessary and are discussed. Four types of drive mechanisms are illustrated and described. Testing of control-rod drives is discussed. (M.P.G.)

5497

ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANTS. HOW TO LOAD SOLID-FUEL REACTORS. J. A. Bolton and P. T. Calabretta (American Machine and Foundry Co., Greenwich, Conn.). *Nucleonics* **13**, No. 6, 52-5(1955) June.

Solid-fuel handling equipment is described for small and large reactors. Small reactors are typified by the pool-type reactor which requires little fuel handling equipment. Loading and unloading can be accomplished manually with boat hooks. The design of equipment for large power reactors depends upon many factors including reactor design, coolant, frequency of refueling, and shielding provided during refueling. The requirements for equipment for frequently and infrequently loaded reactors are compared. Fuel handling systems used in pressurized water reactors and in sodium cooled reactors are illustrated. (M.P.G.)

5498

ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANTS. HOW TO DESIGN REACTOR SHIELDS FOR LOW-EST COST. James A. Lane (Oak Ridge National Lab., Tenn.). Nucleonics 13, No. 6, 56-8(1955) June.

A method for determining optimum shield design for minimum cost is presented. It is assumed that the biological shield protects personnel and that the thermal shield prevents excessive heat generation in the biological shield. Neutron and γ -ray fluxes at the boundary between the shields can be established. The attenuation required can then be determined, which enables each structure to be optimized separately to find the optimum for the entire shield. It is shown that minimum shield costs vary almost linearly with reactor core diameter assuming a cylindrical core with diameter equal to height, barytes concrete for the material of biological shield, and an optimum combination of iron and water for the thermal shield. (M.P.G.)

5499

ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANTS. DETERMINING THE GEOMETRY OF THERMAL SHIELDS. Neal F. Lansing (Oak Ridge National Lab., Tenn.). Nucleonics 13, No. 6, 58-9(1955) June.

Material configuration in the thermal shield must be chosen so that flow and heat-transfer characteristics are satisfactory. Thermal stresses must not exceed permissible values. After selecting the gross quantities of materials needed to achieve the required thermal shield attenuation, the details of material distribution must be established. The thermal shield design procedure is illustrated using a cylindrical reactor core 12 ft in diameter for an example. (M.P.G.)

5500

ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANTS. HOW TO CHOOSE AND PLACE MIXES FOR HIGH-DENSITY CONCRETE REACTOR SHIELDS. Harold S. Davis (Hanford Atomic Products Operation, Richland, Washington). Nucleonics 13, No. 6, 60-5(1955) June.

Reactor shields can be made with ordinary concrete or with high-density concrete made with heavy aggregates such as magnetite or steel punchings. The factors to consider in shield design, the properties of available heavy aggregates, and techniques for the construction of high-density concrete shields are discussed. Tables are presented on the cost, composition, and properties of high-density concrete. Methods for increasing neutron-shielding effectiveness are described. (M.P.G.)

5501

ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANTS. REACTOR VESSELS. B. A. Mong and R. M. Douglass (Babcock and Wilcox Co., Akron, Ohio). Nucleonics 13, No. 6, 66-9(1955) June.

The problems involved in the design and fabrication of vessels to contain reactor cores are discussed. In addition to the usual consideration of pressure, temperature, and corrosion resistance, the following problems must be studied: radiation damage to the vessel materials; thermal stresses due to radiation heating; exceptional reliability since the vessel can not be examined periodically; leaktightness; and closer dimensional tolerances. Vessels for pressurized-water reactors, aqueous homogeneous reactors, and liquid-metal reactors are described. (M.P.G.)

5502

ENGINEERING AND CONSTRUCTION OF NUCLEAR POWER PLANTS. CONSTRUCTION OF THE SRE CORE. R. L. Olson (North American Aviation, Inc., Downey, Calif.). Nucleonics 13, No. 6, 70-2(1955) June.

The core of the Sodium Reactor Experiment consists of 6-ft-long U fuel rods suspended along the vertical axes of hexagonal graphite moderator-reflectors. Zr tubes line the inside holes of the graphite units which are encased in hexagonal Zr cans. Na coolant flows upward through the fuel channels, control channels, and clearance spaces between cans. Diagrams of the SRE core and can assembly are presented. The reactor enclosure and fabrication of the Zr hexagonal cans are described. (M.P.G.)

5503

COST DATA ON THE UNIVERSITY OF MICHIGAN RESEARCH REACTOR. W. K. Luckow and L. C. Widdoes (Univ. of Michigan, Ann Arbor). Nucleonics 13, No. 6, 104-6(1955) June.

The facility for the University of Michigan Research Reactor consists of a 268,000-ft³ reinforced-concrete building containing a 1-Mw swimming-pool-type reactor. The total cost of the project will be about \$1,001,385. The reactor facility is described, and project costs are summarized. (M.P.G.)

NUCLEAR TRANSFORMATION

5504 AEC-tr-2163

THE (d,p) AND (d,n) REACTIONS. (Sur Les Reactions (dp) et (dn). Translated from J. Phys. Radium 14, 695-706(1953). 23p.

The angular distributions from the (d,p) and (d,n) reactions were interpreted by means of a particle scattering theory. It was found that the effect of the reaction due to the elastic scattering of the protons (or neutrons) is shown generally by a reduction of the total effective cross section by a factor of 2 to 5, but that the general trend of the angular distributions is hardly modified. The equivalence of the two approximations, Butler and Born, as a solution of the problem was examined in detail. (C.W.H.)

5505

PAIR SPECTROMETER MEASUREMENTS OF THE RADIATIONS FROM EXCITED STATES OF LIGHT NUCLEI. R. D. Bent, T. W. Bonner, and R. F. Sippel (Rice Inst., Houston, Tex.). Phys. Rev. 98, 1237-44(1955) June.

A magnetic-lens pair spectrometer has been used to study the radiations produced by the bombardment of certain light nuclei with protons and deuterons from a Van de Graaff accelerator. Gamma rays from the bombardment of F^{19} with 3.7-Mev protons were observed at 6.10 ± 0.04 and 6.99 ± 0.04 Mev. At 4.7-Mev bombarding energy, no lines were observed between 7.5 and 11.0 Mev with an intensity as great as 10% of that of the 6.99-Mev line. Gamma rays from the bombardment of C^{13} with 2.0-Mev deuterons were observed at 3.42 ± 0.03 , 3.71 ± 0.05 , 3.94 ± 0.06 , 4.48 ± 0.04 , 4.96 ± 0.03 , 5.12 ± 0.04 , 5.74 ± 0.03 , 6.14 ± 0.03 , 6.53 ± 0.05 , and 6.72 ± 0.03 Mev. At 4.0-Mev bombarding energy, lines were observed at 6.14 ± 0.03 , 6.53 ± 0.04 , 6.72 ± 0.03 , 7.09 ± 0.03 , and 7.34 ± 0.04 Mev. Gamma rays from the bombardment of C^{12} with 4.0-Mev deuterons were observed at 3.76 ± 0.02 and 3.86 ± 0.02 Mev. No lines were observed between 3.86 and 5.8 Mev with an intensity as great as 10% of that of the 3.86-Mev line. All the energies of γ rays given above are uncorrected for

Doppler shifts which in some cases are as large as 40 kev. A search was made for nuclear pairs which might originate from the proton bombardment of B^{11} . No pairs were observed at 4.0-Mev bombarding energy in the energy range between 6.5 and 9.5 Mev. A search was also made for nuclear pairs which might result from the $Li^7(d,n)Be^8$ reaction. No pairs were observed in the energy range between 5.0 and 8.5 Mev. (auth)

5506

ENERGY LEVELS IN B^9 AND Be^7 FROM THE REACTIONS $C^{12}(p,\alpha)B^9$ AND $B^{10}(p,\alpha)Be^7$. J. B. Reynolds (Princeton Univ., N. J.). *Phys. Rev.* **98**, 1289-92(1955) June 1.

The energy levels of Be^7 and B^9 have been studied by observation of the alpha-particle spectra resulting from the reactions $B^{10}(p,\alpha)Be^7$ and $C^{12}(p,\alpha)B^9$. Alpha groups were observed corresponding to the ground state of B^9 and an excited state at 2.39 ± 0.08 Mev. Groups were observed corresponding to Be^7 being left in the ground state and excited states of the following energies: 0.49 ± 0.10 Mev, 4.72 ± 0.08 Mev, 6.27 ± 0.10 Mev, 7.21 ± 0.10 Mev, 14.6 ± 0.3 Mev. (auth)

5507

THERMODYNAMIC THEORY OF FISSION. J. K. Perring and J. S. Story (Atomic Energy Research Establishment, Harwell, Berks, England). *Phys. Rev.* **98**, 1525-6(1955) June 1.

Fong's theory of fission (*Phys. Rev.* **89**, 332(1953)) which showed remarkably good agreement with experimental data for U^{235} was applied to Pu^{239} by the authors. No such agreement was found, and some of the inconsistencies are discussed in this note. (L.M.T.)

5508

INVESTIGATION OF THE (γp) REACTION ON COPPER. E. M. Leikin, R. M. Osokina, and B. S. Ratner (Lebedev Physics Inst.). *Doklady Akad. Nauk S.S.S.R.* **102**, 245-7(1955) May 11. (In Russian)

Experimentally determined energy and angular distributions and yields of photoprotons ejected from Cu by synchrotron γ rays of 19.0, 24.0, 28.0, and 30.5 Mev energy are tabulated and graphed. (G.Y.)

PARTICLE ACCELERATORS

5509 UCRL-2954

California. Univ., Berkeley. Radiation Lab. BEVATRON OPERATION AND DEVELOPMENT. [PART] IV. Bruce Cork, Warren Chupp, and Edward J. Lofgren. Apr. 12, 1955. 15p. Contract W-7405-eng-48.

A considerable amount of work has been done on the magnet power supply. With the system operating at 4.5 Bev with only the even-number ignitrons firing, it has been demonstrated that the high inversion arc-through rate is not necessarily caused by heating of the ignitrons. A large contribution to the high-inversion arc-through rate at high current is now believed to be due to commutation difficulties in the a-c grids of the ignitrons during inversion. (For preceding period see UCRL-2822.) (auth)

5510 UCRL-3010

California. Univ., Berkeley. Radiation Lab. EXPERIMENTS ON IMPROVING THE EFFICIENCY OF THE BEVATRON ION SOURCE (thesis). Troy E. Stone. May 19, 1955. 38p. Contract W-7405-eng-48.

Submitted as a thesis to the United States Naval Postgraduate School, Monterey, Calif.

A study was conducted to determine the focal properties of an ion source that is typical of those used with the Bevatron. Beam-intensity patterns have been obtained for various focusing conditions. The effects of space-charge repulsion and lens aberration have been investigated. Losses through Coulomb scattering on residual gas molecules have been observed, and a curve showing variation of these losses with variation of energy through the focus electrode has been obtained. Pressure throughout the accelerating column was found to be an important factor, and losses occasioned through slight increases in the normal operating pressure have been recorded. All previous ion sources for the Bevatron have been designed for presentation of a real image to the subsequent injection system. A virtual-image source has been designed, constructed, and tested on the Bevatron. (auth)

5511 AEC-tr-2178

HIGH VOLTAGE ELECTROSTATIC GENERATOR IN COMPRESSED GAS. B. V. Baev, P. E. Vorotnikov, B. M. Gokhberg, N. I. Sidorov, A. B. Shuf, and G. B. Yan'kov. Translated from *Doklady Akad. Nauk S.S.S.R.* **101**, 637-9(1955). 5p.

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 9-5169.

5512

HIGH-FREQUENCY ION SOURCE. V. M. Morozov (Vavilov Inst. of Physical Problems). *Doklady Akad. Nauk S.S.S.R.* **102**, 61-4(1955) May 1. (In Russian)

5513

SMALL ELECTROSTATIC GENERATOR IN COMPRESSED GAS. G. V. Gorlov, B. M. Gokhberg, V. M. Morozov, and G. A. Otroshchenko (Vavilov Inst. of Physical Problems). *Doklady Akad. Nauk S.S.S.R.* **102**, 237-9(1955) May 11. (In Russian)

The design of a 1.6- to 1.7-Mv belt-type electrostatic generator yielding a 100- μ a current is described. (G.Y.)

RADIATION ABSORPTION AND SCATTERING

5514

ANISOTROPIC DIFFUSION LENGTHS IN DIFFUSION THEORY. Bernard I. Spinrad (Argonne National Lab., Lemont, Ill.). *J. Appl. Phys.* **26**, 548-50(1955) May.

A set of formulas defining diffusion lengths in heterogeneous assemblies is presented. Even in the homogeneous limit, these formulas lead to anisotropic diffusion lengths for systems such as rod or slab assemblies which are microscopically anisotropic. (auth)

5515

NEUTRON ABSORPTION IN A SEMI-INFINITE REGION. J. S. Dwork (Univ. of Vermont, Burlington) and H. Hurwitz, Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). *J. Appl. Phys.* **26**, 642-3(1955) May.

The Wiener-Hopf method has been used to calculate the neutron absorption in a region 1 occupying the half-space $z < 0$ when there is a uniformly distributed isotropic and monoenergetic neutron source in a region 2 which occupies the half-space $z > 0$. The ratio p_1 of scattering cross section to total cross section in region 1 is assumed to differ from the corresponding ratio p_2 in region 2. The scattering in the two regions is assumed to be isotropic and not to change the neutron energy. The net flow of neutrons per unit time from region 2 to region 1 per unit area of interface is

found to equal AS where S is the number of neutrons emitted by the source per unit time and volume in region 2 and A is given by the relationship $A = \lambda_2(1-p_1) f(p_2) - f(p_1)/p_2 - p_1$.
[auth]

5516

MONTE CARLO CALCULATION OF GAMMA-RAY ALBEDOS OF CONCRETE AND ALUMINUM. J. F. Perkins (Convair Aircraft Corp., Fort Worth, Tex.). *J. Appl. Phys.* **26**, 655-8(1955) June.

Number and energy gamma-ray albedos have been calculated for a material of $Z_{\text{eff}} = 13$, corresponding to both concrete and aluminum. The Monte Carlo method was used, the calculations being performed on an IBM-701. The single- and multiple-scattered components were evaluated separately; the multiple-scattered component was considerably the larger of the two in most cases, being as much as three times as large as the single-scattered component. For moderately small incident angles, the emergent photons are distributed approximately proportional to the cosine of the normal angle of emergence. The spectra peak around 150 to 250 kev and in some cases have a second peak at higher energy; such secondary peaks move upward in energy and in crease in importance as the angle of incidence increases. The average energy of the emergent photons varies from 0.33 to 1.4 m_0c^2 . For the multiple-scattered component the average energy varies from 0.30 to 0.93 m_0c^2 . Buildup factors have been calculated for 2 m_0c^2 gammas normally incident on aluminum of 2 and 4 mean free paths thickness.
[auth]

5517

NEUTRON-PROTON SCATTERING AT SMALL ANGLES. J. J. Thresher, R. G. P. Voss, and R. Wilson (Univ. of Oxford, England). *Proc. Roy. Soc. (London)* **A229**, 492-509 (1955) May 24.

Neutron-proton scattering has been measured from 6 to 61.5° c.m. for neutrons of effective energy 105 ± 3 and 137 ± 5 Mev using a liquid hydrogen scatterer and a large neutron counter. The results confirm previous measurements and show a near symmetry around 90° at 105 Mev, and a fairly definite asymmetry at 137 Mev. The 'Serber force' does not, therefore, give a good approximation to the experimental data at 137 Mev. (auth)

5518

THE EFFECT OF MULTIPLE SCATTERING ON ELECTRON ENERGY LOSS DISTRIBUTIONS. D. F. Hebbard and P. R. Wilson (Univ. of Melbourne, Australia). *Australian J. Phys.* **8**, 90-7(1955) Mar.

Calculations have been performed to obtain the theoretical energy loss distributions of 1-Mev electrons traversing foils thick enough for multiple scattering to be important. A criterion has been developed and applied to previous experiments to determine the foil thicknesses for which multiple scattering has an appreciable effect on the energy loss distribution. (auth)

5519

THE ENERGY LOSS DISTRIBUTIONS OF 1 MEV ELECTRONS IN ALUMINIUM FOILS. J. A. McDonnell, M. A. Hanson, and P. R. Wilson (Univ. of Melbourne, Australia). *Australian J. Phys.* **8**, 98-107(1955) Mar.

The energy loss distributions for 1-Mev electrons traversing aluminium foils of various thicknesses have been investigated experimentally. Several of the foils were of thicknesses such that the distributions were expected to

show considerable effects due to multiple scattering. It was found that the most probable energy losses were in good agreement with those predicted by the calculations of Hebbard and Wilson. (*Australian J. Phys.* **8**, 90(1955)). (auth)

5520

INELASTIC COLLISION CROSS SECTIONS AT 1.0-, 4.0-, AND 4.5-MEV NEUTRON ENERGIES. J. R. Beyster, R. L. Henkel, R. A. Nobles, and J. Kister (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **98**, 1216-24(1955) June 1. (cf. NSA 9-2443)

Inelastic cross sections have been obtained from measurements of sphere transmission for incident neutron energies of 1.0, 4.0, and 4.5 Mev. Cross sections were measured for Al, Fe, Cu, Zn, Ag, Cd, Sn, Au, Pb, and Bi at the three neutron energies. In addition, the carbon inelastic cross section was measured at 1.0 Mev, the Be, C, Ti, Ni, Zr, and W cross sections were measured at 4.0 Mev, and the Ti, Ni, Zr, and W were measured at 4.5. The cross sections were determined at about ten energy thresholds of the neutron detector to obtain information about the energy spectra of inelastic neutrons. The experimental techniques and the method of evaluating the measurements are discussed. The results of this investigation are compared with other determinations of inelastic cross sections. (auth)

5521

ANGULAR MOMENTUM COUPLING IN DEUTERON REACTIONS. T. Auerbach and J. B. French (Univ. of Rochester, N. Y.). *Phys. Rev.* **98**, 1276-80(1955) June 1.

Information about nuclear coupling schemes which can be derived from relative cross sections in deuteron stripping and pickup reactions in light nuclei is considered. In a few cases, experimental results are applied to give a determination of the intermediate-coupling parameter. (auth)

5522

ANGULAR DISTRIBUTION OF FAST NEUTRONS SCATTERED FROM LEAD. W. J. Rhein (Univ. of Texas, Austin). *Phys. Rev.* **98**, 1300-1(1955) June 1.

The elastic differential cross sections for the scattering of 1.0-, 3.7-, 5.0-, and 15.0-Mev neutrons from lead have been measured, using a minimum of experimental variables in order to investigate the behavior of these cross sections as a function of neutron energy. The scatterers were ring-shaped, permitting a scattering range between 10 and 150°. The neutrons were counted with ZnS-plastic scintillators. It was necessary to subtract the effects of inelastically scattered neutrons from the experimental results in order to arrive at the elastic cross sections. The results show the expected prominent variation in the width and height of the forward scattering peak and indicate that the number and direction of the secondary maxima of scattering are a prominent function of neutron energy. (auth)

5523

SCATTERING OF HIGH-ENERGY ELECTRONS BY NUCLEI. A. E. Glassgold (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **98**, 1360-9(1955) June 1.

Calculations of elastic scattering of electrons have been carried out for simple, spherically symmetric charge distributions. The atomic numbers considered are $Z = 13, 29, 50, 74$, and 79, and the electron energy varies from 15 to 90 Mev. The results for the homogeneous and shell distributions indicate that shape independence exists for energies such that $kR_h \lesssim 1.5$, where R_h is the radius of the homogeneous model and k is the electron wave number. This is a

consequence of requiring that these two densities have the same mean square radius or second moment. The assumption that the scattering at higher energies depends on higher even moments has also been investigated. The scattering was calculated as a function of the fourth moment at an energy just above the shape independent region. Equating the second and fourth moments of two charge densities results in identical scattering for scattering angles up to 120° , but beyond this point the scattering differs by about 10%. An analysis of the existing experiments below 100 Mev indicates that the mean square radius of the nuclear charge density is given by a homogeneous distribution of radius $R_h = r_0 A^{1/3} \times 10^{-13}$ cm, with $r_0 = 1.2$ to within 10%. (auth)

5524

DIRECTION OF PROTON SPIN POLARIZATION PRODUCED BY ELASTIC SCATTERING. L. Marshall and J. Marshall (Inst. for Nuclear Studies, Chicago). Phys. Rev. **98**, 1398-1401(1955) June 1.

A measurement has been made of the direction of spin polarization produced by elastic scattering of high-energy protons. 435-Mev protons were polarized by scattering elastically from beryllium to the right at 14° after which they were slowed to 0 to 20 Mev and scattered again elastically from helium. From the measured energies and angles of the scattered protons as recorded in photographic emulsions, together with the calculated polarizations resulting from interferences among the levels of the double P state involved in proton-helium elastic scattering, we find that the polarization of the proton beam is directed down. This result has been predicted by an hypothesis which extrapolates to high energies the effect of the spin-orbit coupling postulated for the nuclear shell model. (auth)

5525

π^- -NUCLEON COLLISIONS AT 1.5 BEV. W. D. Walker and J. Crussard (Univ. of Rochester, N. Y.). Phys. Rev. **98**, 1416-27(1955) June 1.

The results of an extensive search for the interactions of 1.5-Bev π^- mesons with nucleons in nuclear emulsion are given. By comparing the cross section for π^- -p interactions in emulsion to the cross sections as measured by counters, it is deduced that half the " π^- -p" collisions are collision of π^- with protons on the edge of a nucleus. Arguments are presented to indicate that the basic features of the π^- -p interactions are not seriously disguised by the struck nucleons being in a nucleus. The elastic scattering seems to be largely diffraction scattering. Because of the large number of partial waves participating, it is not possible to interpret the differential elastic cross section unambiguously. However it seems certain that partial waves at least as high as the F wave participate in the reactions. The angular distribution indicates that the S and P waves are either strongly absorbed or scattered or both. The data seem to be consistent with a nucleon model consisting of a core of about 0.5×10^{-13} cm radius plus a field extending out to about 1.0×10^{-13} cm. The inelastic collisions have the following features. The nucleons seem to go on the average into the backward hemisphere in the center-of-mass system after the collision. The more energetic of the two mesons usually goes into the forward hemisphere. The slower meson seems to be fairly closely correlated in angle with the nucleon. In the cases of π^0 production, the π^0 is the fast meson about one-half the time. The production of π^0 and π^+ in π^- -p collisions seems to occur with about the same frequency. Also collisions are found which seem to be

π^- -n collisions. The production of an additional π^0 seems to be the most common process in these collisions. The π^- -n collisions seem to be consistent with meson production occurring by means of the production of an excited nucleon in a $T = \frac{1}{2}$ state which decays with the emission of a meson. The π^- -p collisions do not seem to be consistent with such a process since the ratio of the number of π^+ to π^0 productions are not as predicted by theory. Also the Q of decay of such an excited nucleon seems to vary from 50 to 350 Mev. This would indicate that the excited state lives for such a short time that it may not be a very useful concept. A short summary of the data on stars is also given. (auth)

5526

DIFFERENTIAL p-p SCATTERING CROSS SECTIONS AT 419 MEV. J. Marshall, L. Marshall, and V. A. Nedzel (Inst. for Nuclear Studies, Chicago). Phys. Rev. **98**, 1513-14 (1955) June 1.

The authors (Phys. Rev. **93**, 927(A) (1954)) presented differential cross sections for p-p scattering at 419-Mev incident energy as a function of angle. The incident beam was subsequently found to be about 50% polarized, and the polarization of H was measured at 439 Mev and found to be positive at lab. angles $<45^\circ$. Consequently, the p-p differential cross sections have been re-evaluated for unpolarized protons and results are presented. (L.M.T.)

5527

PHASE SHIFT ANALYSIS OF 240-MEV PROTON-PROTON SCATTERING. L. Beretta, E. Clementel, and C. Villi (Univ. of Padova, Italy). Phys. Rev. **98**, 1526-7(1955) June 1.

Proton-proton scattering at 240 Mev is discussed on the basis of Towler's experimental data (Phys. Rev. **84**, 1262(1951); **85**, 1024(1952)). (auth)

5528

CALCULATION OF THE FIELD OF RADIATION STRIKING A ROUND TARGET FROM A ROUND SOURCE. K. A. Petrzhak and M. A. Bak. Zhur. Tekh. Fiz. **25**, 636-43(1955) Apr.

RADIATION EFFECTS

5529 EGG-1068

Edgerton, Germeshausen and Grier, Inc., Boston. SENSITIVITY OF FILMS TO GAMMA RADIATION. Oct. 10, 1952. 22p.

The danger of losing valuable photographic data due to fogging of film by gamma radiation has highlighted the need for reliable data on film sensitivity to radiation. The sensitivity to prompt radiation of a wide range of photographic emulsions is compared. Further work is in process to contribute to a firmer understanding of the process of radiation fogging aimed at the design of an emulsion with a higher ratio of light sensitivity to radiation sensitivity. (auth)

5530

EFFECT OF REACTOR IRRADIATION ON THE WHITE-TO-GREY TIN TRANSFORMATION. Jerome Fleeman and G. J. Dienes (Brookhaven National Lab., Upton, N. Y.). J. Appl. Phys. **26**, 652-4(1955) June.

The effect of low-temperature (liquid nitrogen) reactor irradiation on the white-to-grey tin transformation has been investigated. It was found that, compared to an unirradiated pure sample, the transformation, measured by dilatometry, is drastically accelerated by prior irradiation. The irradiation

tion apparently eliminates the normally very long induction period. The kinetic behavior of reactor irradiated samples and of samples seeded with grey tin were found to be qualitatively similar. These results indicate that the defects introduced into white tin by reactor irradiation serve as nuclei, or at least embryos of nucleation, for the subsequent phase transformation. Whether point defects, their aggregates, or the strains surrounding the displaced atoms are responsible for the artificial "seeding" cannot yet be decided. Reactor irradiation appears to be a promising new tool for studying nucleation and growth processes since quite uniform artificial nucleation can be accomplished this way. (auth)

RADIOACTIVITY

5531 IDO-16218

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

DECAY GAMMA ENERGY SPECTRUM FROM URANIUM FISSION PRODUCTS. L. H. Boyer. Apr. 13, 1955. 27p. Contract AT(10-1)-205.

Used MTR fuel assemblies are now employed as powerful sources of gamma ray energy for use in experiments. A method of estimating the gamma ray intensity from a fuel assembly in terms of its operating history has been needed. This report presents graphs from which the total Mev/sec, or the Mev/sec within any of 14 energy groups covering the range 0 to 3.2 Mev, can be calculated knowing the time the fuel assembly is in the reactor and in its cooling time. (auth)

5532

BETA EMITTERS BY ENERGY AND HALF-LIFE. Naomi A. Hallden (U. S. Atomic Energy Commission, New York). *Nucleonics* 13, No. 6, 78-9(1955) June.

A table is presented in which beta emitters are tabulated by energy and half life. Only isotopes with half lives greater than 6 hr are listed. (M.P.G.)

5533

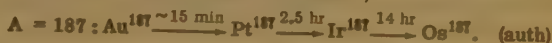
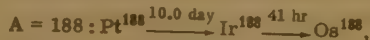
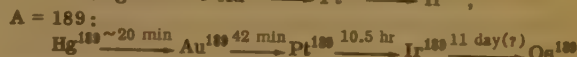
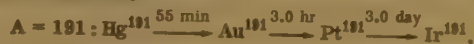
RADIONUCLIDES Al^{24} , P^{32} , Cl^{32} , AND Sc^{46} . Neel W. Glass and J. Reginald Richardson (Univ. of California, Los Angeles). *Phys. Rev.* 98, 1251-7(1955) June 1.

Three new short-lived positron emitters, P^{32} , Cl^{32} , and Sc^{46} , of the nuclear series $Z = 2n + 1$, $A = 4n$ have been produced by p-n reactions using 20-Mev protons from the UCLA 41-in. FM cyclotron. Al^{24} has a half-life of 2.10 ± 0.04 sec and 5 γ rays from 1.39 to 7.12 Mev. 2-Mev α particles are emitted in a small fraction of the decays. P^{32} has a half-life of 0.280 ± 0.010 sec, threshold of 15.6 ± 0.5 Mev, 8 γ rays from 1.79 to 7.59 Mev, and positrons of maximum energy 10.6 ± 0.4 Mev. No heavy particles were detected in the decay. Cl^{32} has a half-life of 0.036 ± 0.004 sec, threshold of 14.3 ± 0.5 Mev, 4 γ rays from 2.21 to 4.77 Mev, and positrons of maximum energy 9.5 ± 0.4 Mev. 2 to 3 Mev α particles are emitted in a small fraction of the decays. Sc^{46} has a half-life of 0.22 ± 0.03 sec, threshold of 15.9 ± 1.0 Mev, a 3.75 ± 0.04 Mev γ ray, and maximum positron energy of 9.0 ± 0.4 Mev. No heavy particles were detected in the decay. Possible decay schemes can be set up which involve favored positron transitions to calculated analog levels in the daughters in the cases of Al^{24} , P^{32} , and Cl^{32} . In the P^{32} decay, the positron component to the 1.78-Mev level in Si^{28} has the same ft value as the negatron decay to this level from Al^{28} , thus indicating the similarity of the nuclear wave functions of P^{32} and Al^{28} . (auth)

5534

RADIOCHEMICAL STUDY OF NEUTRON-DEFICIENT CHAINS IN THE NOBLE METAL REGION. W. G. Smith and J. M. Hollander (Univ. of California, Berkeley). *Phys. Rev.* 98, 1258-66(1955) June 1.

A radiochemical study of some neutron-deficient nuclides in the noble metal region has been undertaken, and several new chains identified. The method used to establish genetic relationships was that of timed chemical separations, where the parent activities are initially produced by cyclotron or linear accelerator bombardments. The following chains have been identified:



5535

K-SHELL INTERNAL CONVERSION COEFFICIENTS. R. C. Rohr and R. D. Birkhoff (Univ. of Tennessee, Knoxville). *Phys. Rev.* 98, 1266(1955) June 1.

Internal conversion coefficients for the K shells of several medium-energy gamma emitters have been measured with a solenoidal beta spectrometer and a 30 mg/cm² lead radiator. Isotopes investigated, with gamma energies and conversion coefficients $\times 10^3$, are as follows: Nb⁹⁶, 722 kev, 1.6 ± 0.8 ; Cd¹¹⁰, 657 kev, 2.2 ± 0.8 ; Te¹²², 570 kev, 6.6 ± 1.7 ; La¹⁴⁰, 541 kev, 5.6 ± 1.9 ; Ce¹⁴⁰, 489, 5.3 ± 2.0 . These values lead to multipolarity assignments of E2 or M1 for the first three, E2 for the La¹⁴⁰, and E1 or E2 for the Ce¹⁴⁰. (auth)

5536

K AND L X-RAY INTENSITIES IN CESIUM-131 DECAY. Richard W. Fink and Berol L. Robinson (Univ. of Arkansas, Fayetteville). *Phys. Rev.* 98, 1293-6(1955) June 1.

A measurement of the relative intensities of the K and L x rays following electron-capture in Cs^{131} is reported. The result may be expressed $[L_I/K + L_{II, III}/K + n]\bar{\omega}_L = 0.106 \pm 0.008$, where L_I/K is the ratio of L_I -shell capture to K-shell capture, n is the probability of an L ionization following a K vacancy, and $\bar{\omega}_L$ is the mean L-fluorescence yield of xenon. Upon combining this with recent theoretical results on electron capture, the mean value of the L-fluorescence yield of xenon is found to be 0.10 ± 0.01 . This value is suggested as a normalization point for the relative photographic values of $\bar{\omega}_L$ in the region $Z = 54$. In order to explain the observed anomalies in inner bremsstrahlung spectra of electron-capture on the basis of p-electron capture, one must conclude that L_{II} -capture is considerably more radiative than L_I -capture, and furthermore, that the probability of radiative capture increases more strongly with Z for L_{II} -capture than for L_I -capture. Traces of 6.2 day Cs^{132} and 13.6-day Cs^{136} were found in the first cesium fraction from pile-irradiated barium nitrate, presumably induced by (n,p) reactions. (auth)

5537

GAMMA RAYS IN THE DECAY OF Na^{25} . John E. Iwersen and W. S. Koski (Johns Hopkins Univ., Baltimore). *Phys. Rev.* 98, 1307(1955) June 1.

Studies of the gamma-ray spectrum of Na^{25} with a scintillation spectrometer showed that gammas with energies of 0.98, 0.59, 0.41, and possibly 0.46 Mev were associated with the decay. The first three gamma rays are compatible with existing energy levels in Mg^{25} . (auth)

5538

POSITRON EMISSION FROM Np^{234} . R. J. Prestwood, H. L. Smith, C. I. Browne, and D. C. Hoffman (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. **98**, 1324(1955) June 1.

An investigation of Np^{234} with a trochoidal analyzer revealed the presence of positrons having an endpoint energy of approximately 0.8 Mev. The ratio of positron emission to electron capture was found to be $(4.6 \pm 1.0) \times 10^{-4}$. (auth)

5539

NUCLEAR PAIRS FROM THE 3.4-MEV STATE IN Ca^{40} . R. D. Bent, T. W. Bonner, and J. H. McCrary (Rice Inst., Houston, Tex.). Phys. Rev. **98**, 1325-6(1955) June 1.

A thick calcium metal target was bombarded with 4.84-Mev protons and a search was made with a magnetic lens pair spectrometer for pairs from the 3.35-Mev state of Ca^{40} . A peak was observed in the spectrometer at an energy of 3.46 ± 0.1 Mev. In a second experiment with a 1 mm Al absorber between the calcium target and a 2-mil lead converter, no external pair peak was observed, indicating that the pairs coming from the target were nuclear pairs and not internally converted gamma-ray pairs. The existence of pairs and the absence of gamma radiation establish the angular momentum of the first excited state of Ca^{40} as zero. (auth)

SPECTROSCOPY

5540 AECU-3035

RAND Corp., Santa Monica, Calif. and Yale Univ., New Haven.

LINE BROADENING BY ELECTRONS: THE VALIDITY OF SIMPLE THEORIES. Roland E. Meyerott and Henry Margenau, May 9, 1955. 12p. For Los Alamos Scientific Lab. [Contract W-7405-eng-36], Subcontract SC-9. (P-672(RAND))

A comparison is made between simple impact theories of line broadening by electrons and recent more detailed quantum calculations. (auth)

THEORETICAL PHYSICS

5541 AEC-tr-2162

A NEW THEORY OF PARTICLES OF ARBITRARY SPIN AND ITS APPLICATION TO THE CALCULATION OF EFFECTIVE CROSS SECTIONS OF COULOMB SCATTERING. (Sur Une Nouvelle Théorie Des Corpuscules De Spin Quelconque Et Son Application Au Calcul Des Sections Efficaces De Diffusion Coulombienne). Gerard Petiau. Translated from J. Phys. radium **14**, 501-9(1953). 19p.

An abstract of this article appears in Nuclear Science Abstracts as NSA 7-6304.

5542

ON POLARIZATION AND SPIN EFFECTS IN THE THEORY OF THE RADIATING ELECTRON. A. A. Sokolov, A. N. Matveev, and I. M. Ternov (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. **102**, 65-8(1955) May 1. (In Russian)

5543

ON QUANTUM FIELD THEORIES. R. Haag. Kgl. Danske Videnskab. Selakab. Mat.-Fys. Medd. **29**, No. 12, 1-37(1955). (In English)

The general conditions which a relativistic quantum theory of interacting particles must satisfy are investigated and brought into mathematical form. Some difficulties connected with the infinite number of degrees of freedom are pointed

out. The fact that the canonical commutation relations no longer have unique solutions must be taken into account in all discussions of field theory. It is shown that the "free field vacuum" of the Tamm-Dancoff method and Dyson's matrix $U(t_1, t_2)$ for finite t_1 or t_2 cannot exist. The possibility of a conventional field theory in which the fields commute for equal times is investigated. (auth)

5544

MESON PAIR THEORY. Abraham Klein and Bruce H. McCormick (Harvard Univ., Cambridge). Phys. Rev. **98**, 1428-45(1955) June 1.

A comprehensive treatment of meson pair theory is presented from the point of view of the Møller scattering matrix and the S matrix. First, the solutions of the classical field equations are used to exhibit the Heisenberg operator for the meson field in terms of the "in" operator of Yand and Feldman. The orthogonality and completeness of this set of one-particle scattering functions is demonstrated. Both the Møller matrix and the S matrix are constructed explicitly as ordered operators by taking advantage of the fact that they generate known linear transformations. Schwinger's dynamical principle is used both for these purposes and to find the nucleon self-energy. Explicit proofs of the unitarity of the scattering matrices are given. The Møller matrix is used as generating function for all Fock-space amplitudes of the system. In this way are exhibited (a) the Green's function renormalization constant (Z_2 of Dyson), (b) the mesic proper field of the source, and (c) that matrix which describes scattering of a single meson. The latter, distinct from the classical one-particle scattering matrix, is obtained by solving a singular integral equation and shown to provide the same meson scattering amplitude. It is seen that only the one-meson amplitude of the one-meson state is singular on the energy shell, in agreement with the simple one-channel form of the S matrix. An alternative treatment of the theory from the point of view of the equations of motion of the source is presented in an appendix. (auth)

5545

NONRELATIVISTIC INTERACTION BETWEEN TWO NUCLEONS. David Feldman (Univ. of Rochester, N. Y.). Phys. Rev. **98**, 1456-70(1955) June 1.

The problem of the derivation of a two-nucleon Schrödinger equation from quantum field theory has been investigated, where only those mesons which are exchanged between the nucleons are taken into account. One expects that the two-particle Schrödinger picture will be useful in the energy (less rest energy) is small ($\tilde{\mu}^2/M$), and if the important matrix elements are those which couple states of small momenta ($\tilde{\mu}$). The procedure which has been followed has been to go over to Fock space in the manner of Tamm and Dancoff, and then to decouple the two-particle Tamm-Dancoff amplitude from all the others by a series of canonical transformations (the over-all coupling is assumed weak). Unlike the methods developed by Lévy-Klein and Bethe-Salpeter, the characteristic difficulties such as energy-dependent and non-Hermitian potentials are avoided. By way of application, the formalism is used to analyze the nonrelativistic nuclear forces for the neutral scalar and charge-symmetric pseudoscalar theories (with both pseudoscalar and pseudovector coupling). In this approximation, it is shown that there is agreement with the results of Lévy-Klein. In the course of the calculations, it is made evident that the "nonadiabatic velocity-dependent" corrections of Lévy-Klein appear even when the nucleons are

taken to be fixed sources. Within the context of the method of canonical transformations, there is no justification for dropping these corrections as has been suggested by Brueckner and Watson. Finally, there is some evidence that the Tamm-Dancoff approximation is not an improvement over weak-coupling perturbation theory when applied to the nuclear-force problem, at least when the coupling constant is small. (auth)

5546

STATISTICAL MODEL FOR HIGH-ENERGY EVENTS.

Joseph V. Lepore and Maurice Neuman (Univ. of California, Berkeley). *Phys. Rev.* **98**, 1494-7(1955) June 1.

The relative probabilities for alternate processes initiated by a nucleon-nucleon collision depend on the dynamics involved and on the volume in phase space accessible to each final state. The assignment of relative a priori probabilities to the final states proportional to their extension in phase must be consistent with the translational, rotational, and Lorentz-invariant properties of the colliding system. The latter in particular implies a conservation law for the center of energy. Its effect is not only to lower the power of the configurational volume by one dimension but also to severely reduce the contributions from high momenta to the phase space integrals. The limitations on accessibility arising from the controllable constants of motion are not sufficient to insure well defined probabilities. Some additional restriction on the configurational part of the phase space must be imposed. A cutoff factor for each particle is accordingly introduced. The configurational volume accessible to the particle thus decreases with increasing energy, a picture not inconsistent with the uncertainty principle. (auth)

5547

MULTIPLE PHOTON PRODUCTION IN QUANTUM ELECTRODYNAMICS. Suraj N. Gupta (Purdue Univ., Lafayette, Ind.). *Phys. Rev.* **98**, 1502-11(1955) June 1.

Multiple production of photons in high-energy processes in quantum electrodynamics is investigated, and the electron-positron annihilation is specially discussed in detail. It is found that at very high energies in cosmic rays, multiple production of up to four or five observable photons can easily take place. But, the probability, according to quantum electrodynamics, for the multiple production of a larger number of observable photons is quite small. (auth)

PATENTS

CHEMISTRY

5548

METHOD AND APPARATUS FOR MEASURING RADIATION QUANTITIES. Newell O. Roberts (to U. S. Atomic Energy Commission). U. S. Patent 2,700,736, Jan. 25, 1955.

Gamma or x radiation is measured by a colorimetric determination of the amount of halogen acid released from a halogenated hydrocarbon by the action of electromagnetic radiation. The device comprises a color responsive radiation sensitive solution and a color comparator chart which enables one to read dosage directly.

5549

RECOVERY OF URANIUM FROM AQUEOUS SOLUTIONS.

James F. Shea and Melvin G. Willingman (U. S. Atomic Energy Commission). U. S. Patent 2,703,271, March 1, 1955.

This process pertains to the efficient and quantitative recovery of uranium from a roasted and carbonate-leached uranium-vanadium ore. The solution is held at 194°F. and sulfuric acid is added to bring the pH to a value between 6.0 and 7.1. The solution temperature is maintained for a period of two to four hours before the uranium containing precipitate is separated.

5550

THE CONVERSION OF FLUORINE TO HYDROGEN FLUORIDE BY SUPERHEATED STEAM. Charles R. Schmitt and Seymour H. Smiley (to U. S. Atomic Energy Commission). U. S. Patent 2,706,676, April 19, 1955.

A process has been developed for the continuous conversion of fluorine to hydrogen fluoride by reacting with the heated fluorine an excess of superheated steam at about 500 degrees F., and continuously removing the reaction products. The temperatures employed are quite critical and depend upon the air dilution of the fluorine.

ENGINEERING

5551

INSULATOR CLAMPING DEVICE. William L. Scott, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,703,337, March 1, 1955.

A device has been made for holding in accurate alignment electrodes or other elements which will be subjected to a considerable temperature range and possibly also a strong magnetic field. Supporting means are provided comprising a clamping arrangement formed of material having a different coefficient of expansion than the material of the insulator and embodying a resiliently deformable member which compensates, when an increase in temperature occurs, for the differential in coefficients of expansion. The clamping device may be arranged so as to be spring loaded, or it may be arcuate in shape having a radius of curvature less than that of an adjacent portion of the insulator.

5552

MEASUREMENT AND CONTROL OF THE COMPOSITIONS OF FLOWING STREAMS OF FLUID MIXTURES. Paul S. Monroe (to U. S. Atomic Energy Commission). U. S. Patent 2,707,964, May 10, 1955.

A method and apparatus have been developed for the continuous measurement of the composition of a flowing fluid stream composed of components having different densities. When one component stream of which a final mixture is partially composed has a varying and uncontrollable composition, a variation in the second component is effected in order to achieve a mixed stream of the desired constant composition. The pressure difference across the orifice, which is a function of the density, is fed back to control the flow rate of the controllable stream.

5553

CAMERA TIMER. Maurice R. Clark (to U. S. Atomic Energy Commission). U. S. Patent 2,708,148, May 10, 1955.

A camera timer has been designed for synchronizing the photographing of a phenomenon and the photographing of other information relating to the phenomenon. This is done by adjusting the rate at which the phenomenon of interest is presented for photography, synchronizing the relative rates of photography of the basic phenomenon and the related parameter, and blanking out effects of the phenomenon at the time that a photograph is being taken of the related parameters.

MINERALOGY, METALLURGY, AND CERAMICS

5554

PRODUCTION OF VANADIUM METAL. Harley A. Wilhelm and John Reed Long (to U. S. Atomic Energy Commission). U. S. Patent 2,700,606, Jan. 25, 1955.

A method has been developed for reducing impure or technical grade vanadium pentoxide to yield ductile massive vanadium metal. The method comprises reacting a mixture of sulfur and the pentoxide with calcium metal, the weight ratio of sulfur to the pentoxide being approximately one to eight and the calcium present in greater than a 50% stoichiometric excess over the amount necessary to react with the pentoxide and the sulfur. The reaction mixture is heated to about 700°C in a reduction bomb.

5555

APPARATUS FOR VAPOR COATING BASE MATERIAL IN POWDER FORM. Rene J. Prestwood and Don S. Martin (to U. S. Atomic Energy Commission). U. S. Patent 2,702,523, Feb. 22, 1955.

The processes for coating powdered base materials with radioactive materials have involved a series of uncontrolled variables each of which decreases the efficiency of the procedure. This patent covers an apparatus for coating such materials by vapor deposition, and comprises a receptacle of three sections, the second of which is of venturi shape. The constricted portion is employed to control the flow characteristics of the radioactive material and thereby regulate the previously determined variable parameters.

5556

TERNARY ZIRCONIUM ALLOYS. Walston Chubb (to U. S. Atomic Energy Commission). U. S. Patent 2,705,674, April 5, 1955.

A zirconium base-tin-molybdenum alloy has been developed which possesses high tensile strength at elevated temperatures, a high degree of ductility, and good corrosion resistance. Preferred ranges of 0.2 to 3.5% molybdenum by weight and 1.5 to 7% tin by weight are specified. The best alloys are, in general, obtained by restricting the tin content to between 1.8 and 4.5% and the molybdenum content to between 0.4 and 3.3%.

5557

BERYL ORE SELECTOR. Antoine M. Gaudin (to U. S. Atomic Energy Commission). U. S. Patent 2,707,555, May 3, 1955.

The $\text{Be}^9(\gamma, n)\text{Be}^8$ reaction is utilized in this method for concentrating beryllium ore. Small pieces of ore containing various amounts of beryllium are passed through a gamma-ray beam from a Van de Graaff or other machine, which produces gamma rays of 1.63 Mev or over. A neutron detector activated by the neutrons emitted from the ore sample, in turn actuates a lever arm which physically displaces the particular ore sample in one direction or another depending upon the neutron flux impinging on the detector.

PHYSICS

5558

ION SOURCE. John S. Luce (to U. S. Atomic Energy Commission). U. S. Patent 2,700,107, Jan. 18, 1955.

An improved ion source has been designed which gives greater efficiency than old devices in delivering positive ions. Means for providing oscillating electron motion are incorporated with a critically positioned defining slot. A substan-

tial reduction is accomplished in the amount of recombination of ionized particles. A more uniform ion distribution is attained, and the amount of deposition of ions and molecules on the source walls is reduced.

5559

POLARITY SELECTOR. Joseph J. Stone, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,700,149, Jan. 18, 1955.

Circuitry has been adapted to receive binary electrical signals of either character and to produce an output signal indicative of the binary character of the input signal. Two output pulses are delivered. The first corresponds to each input signal, and the second to each input signal of a selected binary character.

5560

MASS SPECTROMETRY. Angus E. Cameron (to U. S. Atomic Energy Commission). U. S. Patent 2,703,843, March 8, 1955.

An improved ion source has been constructed to eliminate the memory effect resulting from the incomplete removal of a previous sample and the source geometry change in the ionization region, which is another consequence of cleaning procedures for removing previous samples. The present ion source comprises a single removable, slotted cylindrical member, which serves as a sample holder, volatilization chamber, and ionization chamber. The chamber is removably mounted upon a housing, in exact alignment with a filament, and is readily removed for substitution of a second sample and chamber after each analysis.

5561

VOLTAGE STABILIZED OSCILLATOR. Thomas F. Marker (to U. S. Atomic Energy Commission). U. S. Patent 2,704,330, March 15, 1955.

A means for accomplishing voltage stabilization in oscillators and amplifiers which will operate successfully with a high-impedance potential source at a relatively low expenditure of power is described. The circuit comprises an amplifying vacuum tube, a source of alternating voltage, and the means for stabilizing this voltage. A pair of semiconducting diodes having dissimilar back-resistance characteristics are connected in series opposition to each other and in series with an RC network. The diode and network are connected between the control grid and the cathode of the vacuum tube.

5562

ION PRODUCING MECHANISM. John S. Luce (to U. S. Atomic Energy Commission). U. S. Patent 2,704,335, March 15, 1955.

An ion-producing mechanism provided with a curved filament and a curved defining slot in the plate, which coact so as to provide an arc of curved cross section, has been developed. This arc encloses the ion exit passage and permits maximum operating efficiency and prevents the leakage of neutral vapors from the ionizing chamber.

5563

ELECTRONIC ADDER-ACCUMULATOR. Joseph J. Stone, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,705,108, March 29, 1955.

A novel electrical adder-accumulator has been designed, which operates in a parallel manner on the digits of numbers to be added. Simultaneous addition on computers using decimal notation in part has been found to be impractical because of the necessity of applying a variable correction factor. The present device is provided with a plurality of parallel adder groups, one for each decimal digit of the numbers to be

added. Each unit is subdivided into four adder units, each of which has associated with it an accumulator in which is stored a number, and a gate tube which will pass a pulse changing the accumulator total by one if a predetermined combination of input voltage levels is obtained.

5564

NEUTRONIC REACTOR. Enrico Fermi and Leo Szilard (to U. S. Atomic Energy Commission). U. S. Patent 2,708,656, May 17, 1955.

This patent discloses the basic fundamentals involved in the building and operating of a self-sustaining slow neutron chain reactor employing unenriched uranium. Disclosure is made of a number of reactor designs in which pure metallic uranium elements, or pressed bodies of uranium oxide in combination with the metallic bodies are arranged in a repeated geometrical pattern throughout a continuous body of a neutron slowing down medium, such as graphite or heavy water, in such total amount as to obtain a reproduction greater than one. The bodies may be spheres, psuedospheres, or rods and may be sheathed or not depending on the conditions of operation. Control is obtained by employing materials such as cadmium or boron steel in the form of rods or other configurations which are removably insertable in the structure. In case heavy water is used as the moderator, reactor control can also be obtained by varying the level of the moderator in the core. The patent also discloses the design of an air-cooled graphite moderated nuclear reactor.

5565

METHODS OF AND APPARATUS FOR SEPARATING MATERIALS. Ernest O. Lawrence (to U. S. Atomic Energy Commission). U. S. Patent 2,709,222, May 24, 1955.

The design and method of operation are described for a device known as the calutron useful in effecting macro-scale separation or enrichment of isotopes by electromagnetic

means. Among other things the patent describes apparatus and a method of operation whereby it is possible to operate with ion beam currents many thousands of times greater than in any mass spectrograph. Space charge effects and the spreading of particle velocities are overcome by operating in a critical pressure range of about 10^{-4} to 10^{-5} mm. of mercury, and maintaining the potential of the beam with respect to the walls at a low value.

5566

MAGNETIC-PERIOD MASS SPECTROMETER. Lincoln G. Smith (to U. S. Atomic Energy Commission). U. S. Patent 2,709,750, May 31, 1955.

A magnetic-period mass spectrometer which includes an evacuated chamber placed in a homogeneous magnetic field, has been designed. An ion source located in the chamber emits the charged particles in a direction perpendicular to the magnetic field. The particles follow a circular orbit for 180° whereupon a voltage pulse is applied across the particles parallel to their direction of motion and perpendicular to the magnetic field decelerating the particles and causing them to follow a shorter orbit. After the particles revolve a predetermined integral number of times they are subjected to a second voltage pulse causing further deceleration and prompt impingement upon a detector located in the magnetic field.

5567

SATURABLE REACTOR. Robert L. Anderson, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,709,791, May 31, 1955.

This device for controlling an electric current has but a single winding, is simple in construction, is capable of carrying a very heavy direct current control current with very low losses, and is also capable of efficiently operating upon a radio-frequency voltage.

